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INSIDE: 2ND ANNUAL VME/VXS/VXI PRODUCT DIRECTORY

JUNE 2005

VMEbus Systems

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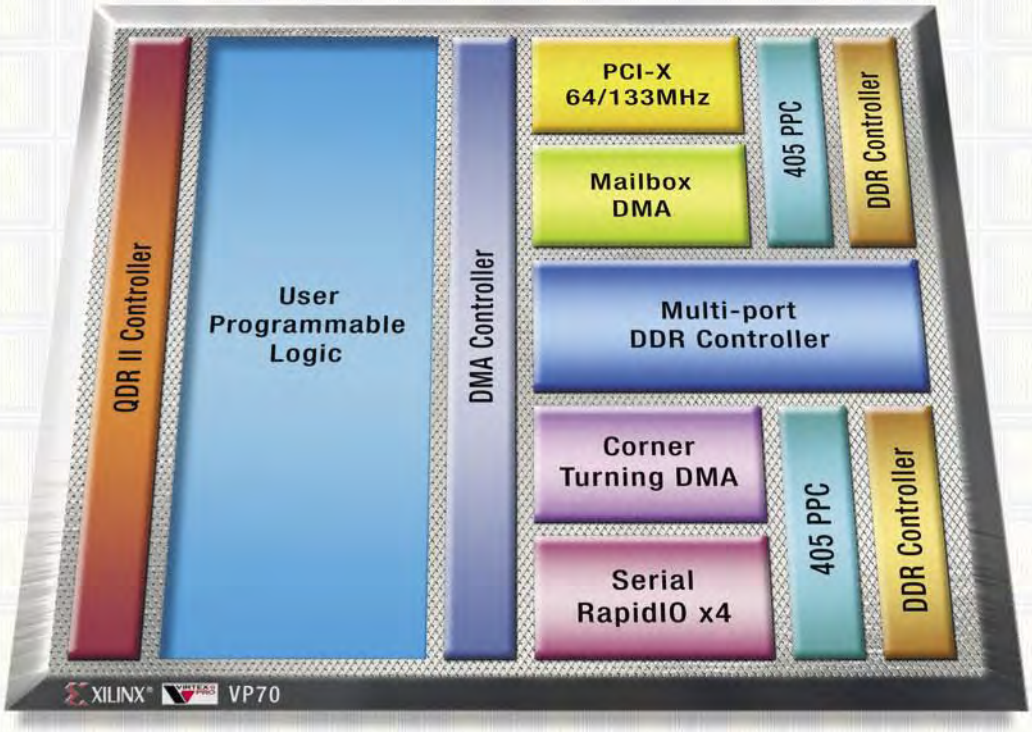

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Volume 23 • Number 3
JUNE 2005

COLUMNS

8 **Editor's Foreword**
What does the Apple-Intel announcement mean to VME?
By Chris Ciufo

10 **VITA News**
Patents take the stage
By Ray Alderman

12 **VITA Standards Update**
By John Rynearson

15 **VITA Standards Activity Chart**

16 **VMEbus Technology in Europe**
By Hermann Strass

18 **Military Technology Insider**
Evolution of switched fabrics within the VMEbus infrastructure
By John Wemekamp

DEPARTMENTS

6 **VME/VXS/VXI Product Directory Advertiser Index**

98 **Advertiser Index**

EVENTS

ESC Boston
Sep 12-15 • Boston, MA
www.esconline.com/boston

IEEE AUTOTESTCON 2005
Sep 26-29 • Orlando, FL
www.autotestcon.com/2005/2005.htm

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COVER
In harsh railway applications, MEN successfully uses VMEbus components for the control of locomotives or track laying equipment, as shown in this picture.
Photograph courtesy of MEN Mikro Elektronik.
VME board image courtesy of Thales Computers.

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FEATURES

SPECIAL: VME I/O Options

22 **Is VXS ready for prime time?**
By Jeff Bateman and Dave Barker, VMETRO

26 **Making the right choice: VME64x, VXS, VITA 46, and VITA 48**
By Jing Kwok, Curtiss-Wright Controls Embedded Computing

32 **FPGAs are the best choice to ride the PCI Express wave**
By Abhijit Athavale, Xilinx Connectivity Solutions

TECHNOLOGY: VXI still on top

39 **What is happening with VXI?**
By Grant Drenkow, Agilent Technologies

42 **Extend VXI systems via hybrid multi-platform automated test systems**
By Faya Peng, National Instruments

46 **Choices: The modular instrument dilemma**
By Mark W. Morris, ZTEC Instruments

53 **VME/VXS/VXI PRODUCT DIRECTORY**

E-LETTER

June: www.vmebus-systems.com/eletter

- FPGA-based Software Defined Radio: Technology and ruggedized military applications
  By Scott Hames, Interactive Circuits and Systems
- Optimized solid state drives for military mission-critical applications
  By Vikram Karnaker, SimpleTech, Inc

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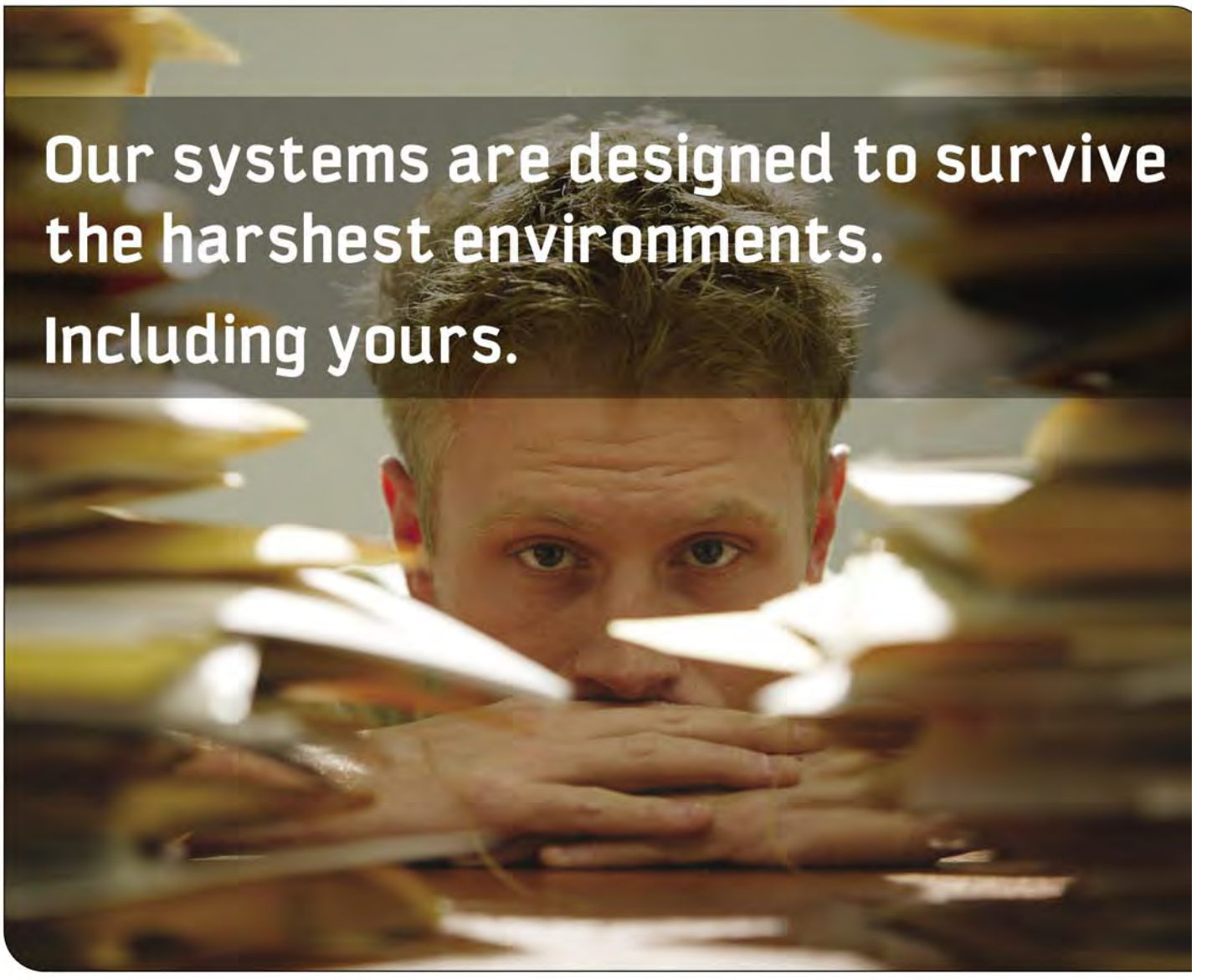

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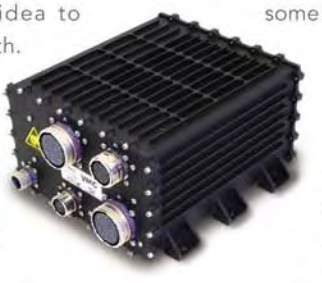

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76	Pentland Systems – Radar tracking
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8001	Red Rock Technologies, Inc. – Mass storage
8002	Red Rock Technologies, Inc. – Mass storage
8101	Ballard Technology – MIL-STD-1553
8102	Hybricon Corporation – Mission critical
82	Hypertronics Corporation – Mission critical
8301	SBS Technologies – Mission critical
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90	Motorola Embedded Communications Computing – PowerPC
91	Creative Electronic Systems – PowerPC
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Editor's Foreword

What does the Apple-Intel announcement mean to VME?

You'll note from the volume number on our cover that *VMEbus Systems* magazine has been published for more than 23 years – it is certainly among the longest running publications serving the embedded industry. So it is with great pleasure, and a fair bit of reverence, that I take over the helm of this magazine that was established shortly after Motorola's original VME public announcement. My first association with the VME specification was about 1990, and I also remember when the VME International Trade Association (VITA) waved the banners at VME's 1992 10-year anniversary. At the time, no one knew VME would last for ten years.

I never could have dreamed that 13 years later I would have the privilege of running the industry's only magazine dedicated to "all things VME." First, I want to thank Senior Technical Editor Mark Barrera for his excellent stewardship of *VMEbus Systems,* and for making the handoff so smooth for me. As you may know, Mark has moved on to running our successful magazine, *Embedded Computing Design*. As the industry heats up, we at OpenSystems Publishing continue to expand our magazine lineup.

You may have missed the recent news from Apple's Developers Conference that starting in late 2006, Apple will switch from IBM PowerPC microprocessors to Intel CPUs. If you're like 97.7 percent of the users in the PC market (according to data by IDC), you use Windows or some other non-Mac equipment. So Apple's recent news is probably a "don't care" to all but 2.3 percent of you. Actually, this switch is *really big* news that has the potential to reverberate throughout the VME community and beyond. First, a bit of background.

As the desktop PC and Macintosh market has moved to commodity status, processor vendors need to find new markets that will pay more than just commodity pricing for value-add feature sets. On the one hand, Windows processor vendors Intel and AMD have been adding dual cores, 64-bit instruction sets, and entire complementary product lines of embedded spin-offs that target cell phones, and portable handheld appliances such as PDAs and MP3/MPEG4 players. On the other hand, Apple's CPUs are PowerPCs sourced by IBM (and previously by FreeScale). IBM, similar to Intel, is broadening its line by focusing on the next-generation video game, entertainment, and high-end server markets.

Rumor has it that Apple was growing increasingly frustrated at IBM's inability to match performance and power with Intel's latest Pentium M product offerings, causing missed processing benchmarks in Apple's product roadmap. Worse, the PowerPCs in Macs have been too power-hungry, forcing Apple to use liquid cooling in high-end G5 towers, and actually avoiding the best PowerPCs for the growing notebook computer market because they use too much power. By switching to Intel, Apple solves its performance and power problems with the stroke of a pen. But that's not the interesting part for the VME community.

The PowerPC microprocessor is used extensively in PMC and VME-based single board computers and multiprocessing modules. Freescale's G4 with AltiVec is the de facto high-end CPU in applications ranging from medical imaging to synthetic aperture radars. In fact, in our online Products database (www.vmebus-systems.com/products/), there are 174 different VME boards, 75 PMC modules, 25 PrPMC modules, and another 600 or so products in other form factors such as CompactPCI or 2U "pizza boxes."

Although IBM's PowerPCs have taken a different direction than Freescale's, without a commitment to Apple, IBM is free to pursue its high-performance passion to the fullest. As early as August 2002, rumors began to circulate that IBM, Sony, and Toshiba were working on a multiprocessing/multi-core single chip called the *Cell* that would dramatically increase number-crunching performance in games and video entertainment applications.

Today, that chip is a 3.2 GHz "supercomputer," a three-core reality that's based upon the PowerPC and destined for the Microsoft Xbox 360. A variant of the Cell chip is also rumored to replace Sony's emotion engine in the PlayStation 3. The Xbox is due out before Christmas 2005, and the PS 3 is targeted for mid 2006. The sheer convection-cooled processing power available in these low cost, living room consumer virtual reality and media center consoles may rival entire chassis filled with current-generation G4 PowerPC-equipped VME boards.

On the Intel side, Apple-inspired higher performing and multi-core Pentium Ms that merely sip current are sure to find their way into next-generation heat- and power-sensitive VME applications where today's G4 PowerPCs just can't go. All in all, the Apple-Intel announcement will give both IBM and Intel just the excuse they need to power next-generation VME systems with exciting new capabilities.

Chris Ciufo
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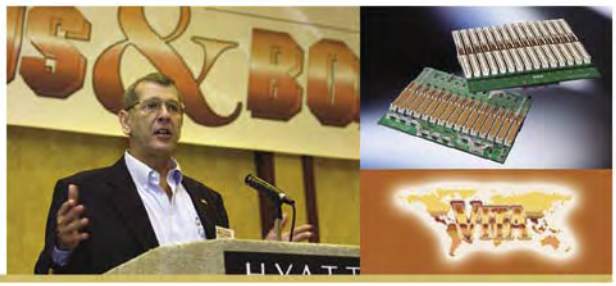

By Ray Alderman

Patents take the stage

As the urban legend goes, Charles H. Duell, commissioner of patents, sent a letter to President McKinley in 1899 urging him to close the patent office because "Everything that could be invented has been invented." Closing the patent office for whatever reason is radical, but the Patent and Trademark Office (PTO) could surely do with a serious makeover. The PTO will patent most anything, whether it makes sense or not. One patent was granted that involved using a laser pointer shined on a white wall to entertain your cat.

Companies reward their engineers who apply for and are granted patents, regardless of the validity or applicability of the invention. It's the *publish* or *perish* mantra often heard in academia, but applied to the engineering department. Some patent activity is simply rooted in making a resume look nice.

Today, patents are taking center stage as technology changes rapidly. There are two basic reasons people and companies apply for patents. These are to make money or to protect a company from patents owned by other companies. Individuals apply for patents to make money. Most companies apply for patents to protect themselves from another company's patents. Large companies trade patents and typically do not pay fees or go to court seeking damages because it is a very expensive process.

The connector industry has been the leader in creating patented technologies and that has affected the board industry, mostly at the standards document level. Sometimes they trade patents with other connector companies, and sometimes they ask for fees and royalties. However, the connector industry is very mature in the area of intellectual property, and most situations are handled equitably.

For patented technologies to be included in an ANSI or IEC standard, the owner of the patent must agree to Reasonable and Non-Discriminatory (RAND) licensing. Many consortia have also adopted the RAND requirements for their specifications. This should allow multiple companies to license and provide the patented technology to users of the standard. But, there is a problem with RAND: the standards developer cannot have any opinion concerning the licensing fees or royalties required by a patent holder for antitrust reasons. The standards committees cannot review or discuss the terms of any license in a meeting, or they could be prosecuted for price fixing.

Even though a company has offered RAND licensing, the terms could be unacceptable to potential licensees. Then, the patent holder has a monopoly for supplying the component required by the standards document, which also creates antitrust issues. To avoid this potential legal infraction, the patent holder will typically license a second source (either by trading patents or other arrangements). But, a duopoly has similar legal concerns. The cost of disputing such patent issues could run into the hundreds of thousands of dollars. We are seeing a number of these issues occurring in the board business, and it will probably get worse.

In the past year, we have seen six patents applications (from two different companies) asserted against the developers and adopters of certain standards documents involving fabric-based backplanes and mezzanine cards. The claims in three of the patent applications (from Company A) were shared with the standards committee. This company wants to insure that the standard involved is open and free to adopters without similar claims from other companies who may have patents. The claims in the other three patent applications (from Company B) were not disclosed to the people working on the standards they affected, and we do not know their intentions at this point.

It is clear that Company A wants to be a good citizen of the standards community. They want to protect their investment in the standard under development, and they want to protect the market potential for the products built to that standard. They are using their patents to the benefit of the standards developer and adopters of that standard. Protection of markets is another use of patents, and this is a perfect example.

We are seeing a number of these issues occurring in the board business, and it will probably get worse.

Hopefully, Company B will follow the example of Company A, and the markets for new, fabric-based technologies at the backplane and mezzanine level can develop and grow, free from the financial threats of patented implementations. But, I see more problems on the horizon.

Company A and B are working members of the standards committees developing the affected specifications. By virtue of their membership on the committees, they have a fiduciary duty to disclose their patent applications. However, companies outside the standards committees have no fiduciary duty to disclose any patents or patent applications they may have that could affect the documents or the markets for fabric-based architectures. They can simply wait until the markets for these types of products develop, and then assert their patents demanding royalties and fees.

From what I have seen, there could be tens or hundreds of patents and patent applications, outside the community of companies who are presently working on the documents, which could affect the future markets of fabric-based computer architectures. We will not know what claims they make until they are asserted against the adopters of the standards.

Ultimately, there is only one basic strategy against both inside and outside patents that apply to standards which is *prior art.* Prior art is a legal term. It is documentation (blueprints, manuals, and so on) and evidence (actual products) that clearly show that the *inventions* in the patents, for example, the claims, were openly used prior to the patent application date. If the prior art *predates and anticipates* the claims in the patent, then the patent can be ruled invalid by a court.

The procedures of a standards developer such as VITA are based on antitrust law. It stands to reason that patent policies of standards developers should be based on patent law. In the future, VITA will continue to adopt patent law solutions to patent assertions against the standards we develop. This would be consistent with VITA's charter of developing open, free, and unencumbered technologies.

In the future, standards developers and consortia must be vigilant in keeping all records and information that can be used as prior art against companies, inside or outside the standards committees, who assert their patents upon the creators and users of the documents. If the cost of litigation is spread over the membership of a standards developer or consortia through the use of a Joint Defense Agreement (JDA), then the legal costs are shared, and no singular company is exposed to high legal fees to defend themselves. Unfortunately, as the markets for fabric-based technologies develop and grow, I expect to see some standards developers assume the duty of protecting and defending their members and their standards documents with prior art and JDAs. It seems to be the only solution that keeps standards open and free to both manufacturers and users.

Ray Alderman *is Executive Director of VITA. Previously, he was CEO of PEP Modular Computers, Technical Director of VITA, and founder and partner at Matrix Corporation.*

VITA *– the VMEbus International Trade Association – was formed in 1984 to promote and enhance the VME standards, and to champion open standards in the embedded computing industry. VITA received accreditation as an ANSI-certified standards developer in 1993, and further received accreditation as an IEC-ITA certified standards developer in 2000.*

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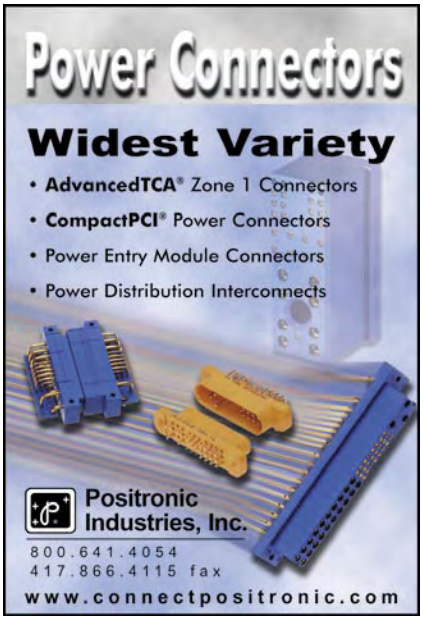

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VITA Standards Update

By John Rynearson

Editor's Note: *The most recent VSO meeting was held May 18-19, 2005 in Long Beach, California. The comments listed here were provided to* VMEbus Systems *prior to that meeting. – Ed.*

VSO ANSI accreditation

Accredited as a Standards Development Organization (SDO) in June 1993 by the American National Standards Institute (ANSI), the VITA Standards Organization (VSO) meets every two months to address vital embedded bus and board industry standards issues. Information on ANSI/VITA standards is available on the VITA website.

VSO study and working group activities

Standards within the VSO may be initiated by a study group, and developed by a working group. A study group requires only one VSO member, and is used to build interest in a standard. A working group requires at least three VITA members, and the proposed work must fit within the defined scope of VITA's accreditation with ANSI.

VITA 41.0 – VME Switched Serial (VXS)

The VXS family of draft standards provides a method for implementing various serial fabric architectures within the VMEbus framework. The base draft VITA 41.0, VXS, completed a working group ballot in early April. The working group is reviewing comments and will decide if changes are required. VITA 41.4, VXS 4X PCI Express, passed a working group ballot in April also. It will be submitted to an ANSI ballot later in the year.

VITA 42 – Switched Mezzanine Card (XMC)

The XMC family of draft standards provides a method for implementing various serial/parallel fabric architectures on a PMC-like mezzanine module. The base level draft standard 42.0 defines the physical changes to the PMC module to support high-speed fabrics. Several dot level draft standards define the appropriate pin assignments for specific fabrics including parallel RapidIO, serial RapidIO, and PCI Express. At the March VSO meeting a new connector was proposed as a possible replacement for the current connector. The new connector would require less insertion/extraction force, but would not be mechanically interoperable with the current connector. The working group is reviewing the issues surrounding switching connectors.

VITA 46 – Advanced Module Format (Working Title)

The VITA 46 working group is developing a 3U/6U 160 mm deep module with a high-performance connector capable of supporting both high-speed parallel and serial fabrics for commercial and military environments. At the March VSO meeting the results of preliminary environmental tests were presented with no major issues being uncovered during the testing. The working group continues to work on the base level draft and anticipates it to go to a working group ballot.

VITA 48 – ERDI

The working group is focusing on Enhanced Ruggedized Design Implementation (ERDI). The goal of this draft standard is to define a general mechanical design implementation for circuit card assemblies that will enhance both their thermal performance and structural integrity. Randy Banton, working group chair, reported at the March meeting that the group had decided to focus on 0.85 and 1.0 interboard spacing. Additionally, he presented preliminary drawings of how liquid cooling could be implemented. Randy indicated that he plans to show prototypes at the next VSO meeting.

VITA 49 – Digital Intermediate Frequency (IF)

The goal of the VITA 49 working group is to develop a new interconnect standard for passing a radio's digitized IF data between computer boards. The group is currently working on the packet framework. Their goal is to have a draft ready by the summer.

VITA 50 – Best Practices for Electronic Module Cooling

Rex Harvey, Parker Hannifin, led the working group in a discussion of a proposed outline for VITA 50 at the March VSO meeting. The group continues to discuss the scope of the effort and how to develop a realistic outline.

John Rynearson *is Technical Director of VITA. Previously, he founded Rystar, Inc. specializing in VMEbus training, and was one of the founders of Mizar, Inc., an early VMEbus company.*

VITA *– the VMEbus International Trade Association – was formed in 1984 to promote and enhance the VME standards, and to champion open standards in the embedded computing industry. VITA received accreditation as an ANSI-certified standards developer in 1993, and further received accreditation as an IEC-ITA certified standards developer in 2000.*

PDF *– This column and the accompanying table is available at the following website: www.vmebus-systems.com/vitastandards*

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For the Current VITA Activity Chart, see page 15.

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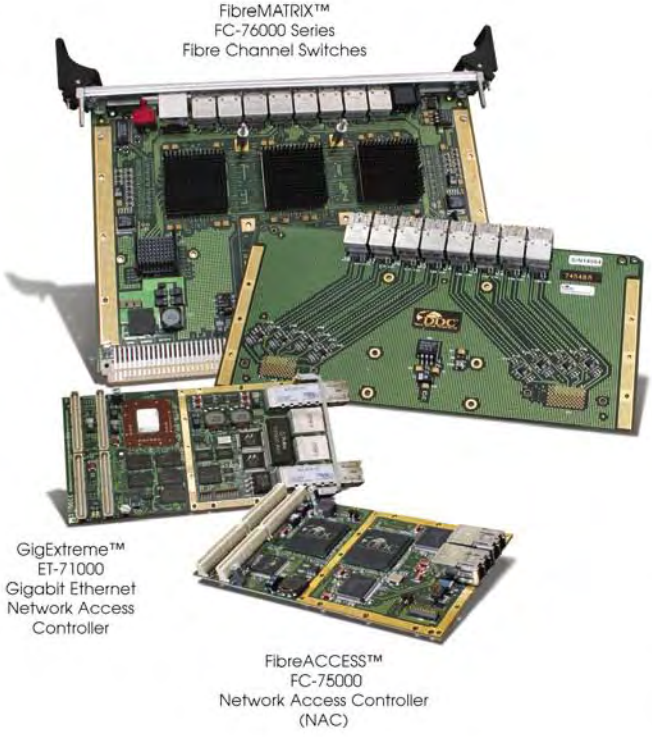

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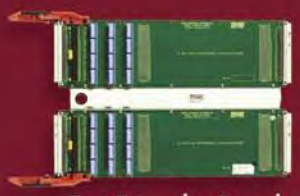

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Current VITA Standards Activity				
Standard	**Title**	**Status**	**Reaffirmed**	**Updated in VMEbus Issue**
ANSI/VITA 1.0	VME64 Standards	Released	2002	
ANSI/VITA 1.1	VME64 Extensions	Released	2003	Aug 2004
ANSI/VITA 1.3	9U x 400mm Format	Released	2003	
ANSI/VITA 1.5	2eSST	Released		Feb 2004
ANSI/VITA 1.6	Keying for Conduction Cooled VME	Released		
ANSI/VITA 1.7	Increased Connector Current Level	Released		
ANSI/VITA 3	Board Level Live Insertion	Released	2002	
ANSI/VITA 4.0	IP Modules	Released	2002	
ANSI/VITA 4.1	IP/I/O Mapping to VME64x	Released	2003	
ANSI/VITA 5.1	RACEway Interlink	Released	2004	
VITA 5.2	RACEway++	Working Group		Aug 2004
ANSI/VITA 6.0	SCSA	Released	2002	
ANSI/VITA 6.1	SCSA Extensions	Released		
ANSI/VITA 10	SKYchannel Packet Bus	Released	2002	
ANSI/VITA 12	M-Modules	Released	2002	
ANSI/VITA 13	Pin Assignments for HIC on VME	Released		
ANSI/VITA 17.0	Front Panel Data Port	Released	2004	
ANSI/VITA 17.1	Serial Front Panel Data Port	Released		Feb 2004
VITA 17.2	Serial Front Panel Data Port Extension	Working Group		Apr 2005
VITA 19.0	BusNet Overview	Canceled		
ANSI/VITA 19.1	BusNet MAC	Released		
ANSI/VITA 19.2	BusNet LLC	Released		
ANSI/VITA 20	Conduction Cooled PMC	Released	2005	Apr 2005
ANSI/VITA 23	VME64x Extensions for Physics	Released		
ANSI/VITA 25	VISION	Released		
ANSI/VITA 26	Myrinet-on-VME	Released	2003	
ANSI/VITA 29	PC•MIP	Released		
ANSI/VITA 30.0	2mm Connector Practice on Euroboard	Released		
ANSI/VITA 30.1	2mm Conduction Cooled Euroboard	Released		
VITA 30.2	Power Connector Equipment Practice	ITA		Apr 2004
ANSI/VITA 31.1	Gigabit Ethernet on VME64x Backplanes	Released		Feb 2004
ANSI/VITA 32	Processor PMC	Released		Feb 2004
VITA 34	A Scalable Electromechanical Architecture	Working Group		Apr 2004
ANSI/VITA 35	Pin Assignments for PMC to VME	Released		
VITA 36	PMC I/O Modules	Working Group		Apr 2004
ANSI/VITA 38	System Management on VME	Released		
ANSI/VITA 39	PCI-X Aux. Std. for PMCs and PrPMCs	Released		Feb 2004
ANSI/VITA 40	Status Indicator Standard	Released		Feb 2004
VITA 41.0	VME Switched Serial (VXS)	Working Group		June 2005
VITA 41.1	VXS InfiniBand Protocol Layer	Working Group		Oct 2004
VITA 41.2	VXS RapidIO Protocol Layer	Working Group		Oct 2004
VITA 41.3	Gigabit Ethernet	Working Group		Apr 2005
VITA 41.4	PCI Express	Working Group		Apr 2005
VITA 41.10	Live Insertion Req. for VITA 41 Boards	Working Group		Oct 2004
VITA 41.11	Rear Transition Modules	Working Group		Apr 2005
VITA 42.0	Switched Mezzanine Card (XMC)	Working Group		June 2005
VITA 42.1	Parallel RIO	Working Group		Apr 2005
VITA 42.2	Serial RIO	Working Group		Apr 2005
VITA 42.3	PCI Express	Working Group		Apr 2005
VITA 42.4	HyperTransport	Working Group		Apr 2005
VITA 43S	Hot-Swap NexGen Mezzanine	Working Group		Feb 2004
VITA 45S	Serial VME	Canceled		Apr 2004
VITA 46	Advanced Module Format (Working Title)	Working Group		June 2005
ANSI/VITA 47	Env., Design and Const., Safety, and Qual. for Plug-In Units	ANSI Recognized		Apr 2004
VITA 48	Enhanced Ruggedized Design Implementation (ERDI)	Working Group		June 2005
VITA 49	Digital Intermediate Frequency (IF)	Working Group		June 2005
VITA 50	Best Practices for Electronic Module Cooling	Working Group		June 2005
VITA 51	Reliability Prediction	Working Group		Feb 2005
VITA 52	Lead Free Practices	Study Group		Apr 2005

For corrections or suggestions, please contact Chris Ciufo, VMEbus Systems magazine at cciufo@opensystems-publishing.com

VMEbus Technology in Europe

By Hermann Strass

Good business in Europe

Business is not booming but is generally quite good throughout Europe and for European companies, despite all the noise about an ongoing recession or flat economy. Consumers are holding back, which is not good for the business in consumer markets. Nonetheless, Industrial Automation (IA) is always strong in Europe. The worldwide market volume of 203 billion EURO ($260 billion) for IA is mostly shared by Europe (34 percent, with 40 percent of this in Germany), the US (25 percent) and Japan (19 percent). Another piece of statistical information, presented at Hannover Fair held in April, indicated that Germany exports about 86 percent of the process automation equipment and services it produces to other European countries and to the US. However, Eastern markets are gaining at an extraordinary rate (China +20 percent, Russia +17 percent). Germany has regained the title of the world's largest export nation in 2004, surpassing the US by a small margin.

Business information

Boards & Solutions conferences were held in the UK (Reading, Birmingham, and Edinburgh) and in Germany (Berlin) between mid-April and early May. I did a presentation about cooling issues on behalf of VITA Europe at the Berlin event. In the exhibition, VMEbus and other platform products were shown including a very large liquid/air-cooled rack from Rittal. The Berlin event was colocated with the Second International Service Availability Symposium which focuses on high availability and related issues for AdvancedTCA and other systems in telecom environments. The new Service Availability Forum president, Depak Shahane from Motorola delivered the keynote address at Boards & Solutions.

Hannover Fair in Hannover (Germany) is the world's largest industrial fair. There is always inclement weather in Hannover in April. Maybe that is a reason why exhibitors are happy with booth attendance. Everybody stays inside the 30 exhibition halls to escape from rain, wind, and occasionally snow outside. This year about 205,000 visitors (17 percent more than last year) made their way to Hannover to meet with many of the more than 6,000 exhibiting companies on about two million square feet of floor space. Interkama (a process control sub fair), now part of Hannover Fair, includes factory automation, motion/drives, digital factory, subcontracting, and several other sub fairs. The largest number of foreign exhibitors came from the combined China (including Taiwan and Hong Kong). About 47 percent of the exhibitors were international, showing the importance of international trade.

SBS Technologies Europe (Germany) reported great business in Europe with plus 40 percent sales in Q3 (ended March 31, 2005) of FY 2004/2005 (minus 13 percent in the Americas), compared with Q3 of the previous year. The nine-month period figures are even more impressive with plus 60 percent in Europe and plus 5 percent in the Americas. Adrian Bernhard, CEO of SBS in Europe welcomed the Lord Mayor Wengert of Augsburg and other dignitaries at the topping-out ceremony held at the end of April for their new building expansion. The Lord Mayor Wengert spoke at the ceremony and congratulated SBS Technologies Europe for their achievements (Figure 1).

Figure 1

The current office and production space which is in a former university building is too small for a significantly increasing business volume. The new building will provide expansion space for more business in the future (Figure 2).

Figure 2

Some of the boards made by SBS in Augsburg, Germany operate in outer space, in the International Space Station (ISS) which is manned by astronauts from the US, Russia, and other countries. Other SBS boards work in oil pipeline control stations in the Siberian Taiga in Russia ensuring that crude oil is pumped reliably all the way from Arctic Siberia through several European countries into refineries in central Europe.

VMEbus technology products

Actis Computer (Switzerland) started a new family of Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)-compliant VMEbus boards which can be used to replace "old" end-of-life 68K and PowerPC-based processor cards with legacy VMEbus Rev C protocol. These "new" boards can run in a Rev C environment but use the PowerQUICC low-power version of CPU chips and other modern features such as one or two PMCs, CompactFlash, and SATA hard disk controllers. The VSBC6847 uses an MPC8247 chip to operate on 6 W for the complete board. The VSBX-6560 is based on an MPC8560 PowerQUICC. In both cards an FPGA generates the Rev C VMEbus interface and controls the Flash and SDRAM memory blocks.

Actis has also implemented a VMEbus DMA with direct data transfer between SDRAM and VMEbus memory addresses. These products provide smooth migration from old protocol (Rev C) and old processors (68K) to new software (including Board Support Packages (BSPs) for VxWorks, and Linux) and to new hardware (PowerQUICC) complying with new requirements which include lead-free and RoHS). For more information on lead-free, visit www.compactpci-systems.com/columns/Technology_in_Europe.

Kontron Modular Computers (Germany) introduced the VMP3 VMEbus CPU board (3U) based on the Freescale PowerQUICC RISC processor (MPC8541) which delivers 1520 MIPS in a Dhrystone 2.1 benchmark using only 10 W of DC power (Figure 3). It supports two 1-Gigabit Ethernet ports, encryption (IPSec) and uses only 10 W of power. The board can boot from and its OS can be updated via Ethernet/IP.

Figure 3

MicroSys (Germany, Miriac in the US) is featuring RPM, a new generation of rugged 6U single board VMEbus computers based on the Pentium Dothan processor, either in a 5 W or 10 W version (Figure 4). Also, there is a conduction-cooled, shock and vibration resistant version in accordance with the IEEE 1101.2 norm. The CPU board includes all the usual PC-related ports and features, and it is bootable from an onboard CompactFlash card. The two ANSI/VITA 31.1 compliant Gigabit Ethernet ports are routed to the VME64x backplane.

Figure 4

Schroff (Germany) expanded its card cage product line with an 8U VME64x chassis. The "box" with 21 slots is Electromagnetic Interference (EMI) protected and can accommodate rear I/O modules. The fan section with three fans and a Fan Control Module (FCM) in a pull-out drawer takes 2U out of the 8U chassis. The open-frame power supply supplies 600 W of DC power with Power Factor Correction (PFC) from a wide range of AC input voltages.

Hermann Strass *is an analyst and consultant for new technologies, including industrial automation, computer bus architectures, mass storage technologies, and industrial networking. He is an active member of several national and international standardization committees, and is the VITA Europe Technical Coordinator for European activities.*

For more information, e-mail Hermann at: hstrass@opensystems-publishing.com

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Evolution of switched fabrics within the VMEbus infrastructure

By John Wemekamp

The introduction of 2.5 GHz+ signaling capability and new switched fabrics could bring the greatest changes to military VMEbus products and their architecture since the introduction of the VME standard itself more than 20 years ago. PCI Express (PCIe) has been adopted by Intel as their next generation of interconnect technology. It has scalable performance by means of serial data channels, which can be increased in number from 1 to 32. This scalability provides for low-cost device adapters such as PCIe to USB through to the highest performance as "big pipes" needed for digital video distribution and similar applications. Advanced Switching is a serial switched fabric layered on PCIe that maintains the performance of PCIe while adding peer-to-peer communications protocols on top of the standard PCIe physical and data link layers. The other interconnect to consider is Serial RapidIO (SRIO), supported by the members of the RapidIO Industry Association providing low-latency, high-bandwidth connections that will be found increasingly in Digital Signal Processing (DSP) applications such as radar and sonar.

There are very many simple military embedded computing applications that can be implemented using just one VMEbus SBC in a chassis with some I/O cards – fire control, navigation, engine management, and so on. There is also a large class of applications that require more than one SBC in the rack to meet their performance and functionality needs. While sophisticated multicomputer DSP engines with arrays of quad G4 PowerPC processors are an economical and efficient solution for radar and sonar systems, there are many other tasks that can be accomplished using a number of dedicated SBCs in a rack, able to communicate between themselves and to share and swap data. These applications continue to make traditional SBCs the ideal choice in multiprocessor configurations.

Typical of such an application might be a naval multifunction display console taking processed data from many different sources such as radars, IR sensors, sonars, data links, or electronic warfare systems. The console's role might range from being a commander's display needing access to multiple sources of correlated and highly processed data, to a sonar display which requires much higher definition and detail from just one type of sensor. Figure 1 depicts typical naval vessels with Tactical Command Systems based on VME.

In this kind of application (typically using between two and eight SBCs in a chassis) the SBCs could communicate over VMEbus but, because of VME's performance limitations, this would often be supplemented with 100 Mbps or 1 Gbps Ethernet links between processors in a PICMG 2.16-like configuration with centralized switches. However, the advent of new standards and fabrics such as PCIe and Advanced Switching (AS) can make for more integrated solutions that promise to have a major impact on both the architecture and performance of future SBCs.

No more PCI headroom

Today's typical high-performance SBC uses the parallel, multi-drop PCI (or PCI-X) bus to hook up its peripheral devices, PMC sites, and the VMEbus to a Northbridge. However, PCI has reached its natural development limit in terms of bandwidth (500 MBps at 64-bit, 66 MHz). Further increases would be costly and complex and, as it is a parallel bus, would need extra real estate for routing on boards and backplanes if it were to be made wider or faster. PCIe replaces the parallel PCI bus with a switch and high-speed point-to-point duplex connections clocked at 2.5 GHz. Despite the change in architecture of PCIe, it exactly replicates the PCI to PCI interface from the user's perspective. Changing from a parallel PCI architecture to a switched PCIe architecture should be transparent.

Figure 1

The configuration and software layers of PCIe remain unchanged from PCI but the transport layer changes to a packet-based protocol for moving data from point to point (agent to agent) via the switches. The physical layer uses industry-standard low voltage differential pairs, one pair for transmit and one for receive. The clock is embedded using 8B/10B encoding and at 2.5 GHz, PCI Express can move data at 250 MBps in each direction. The width (and hence the bandwidth) of a PCIe link may be linearly scaled by adding further differential pairs in each direction, up to 32 lanes wide. Agents with different numbers of lanes can talk to each other through the switch by negotiation at configuration time.

Figure 2 illustrates a typical, current generation Single Board Computer (SBC) im-

plemented using parallel PCI and PCI-X buses and also shows how this same functionality would change to incorporate PCIe. It can be seen that the two parallel PCI buses are replaced by a switch and multiple point-to-point PCIe connections. In order to retain compatibility with existing PMC mezzanine modules, a PCIe to PCI-X bridge can be used to provide the parallel PCI-X bus connection at the PMC site itself. Newer PMC modules will also implement the VITA 42 XMC standard with its additional high-speed connectors that will accommodate a connection from the SBC basecard to the PMC module. This new connector type will support PCIe from the basecard to the PMC.

PCIe ecosystem and architecture

As PCIe is being adopted by Intel and the much broader PC world there will be a wealth of new device types being introduced that will be supported with PCIe interfaces. This level of market acceptance will drive down the cost of the new PCIe-based silicon and offer many supplier choices to the embedded SBC developer. PCIe can also be routed off-board and across backplanes to provide processor-to-processor links or to access remote PMC devices or other I/O modules. The need to route signals such as PCIe, switching at 2.5 GHz from an SBC through the backplane connectors and across the backplane, was one of the catalysts for the development of the VITA 41 and VITA 46 standards.

Both these standards will use the Tyco/FCI MultiGig RT connector between board and backplane providing connectivity that can be used for many different high speed interconnects and fabrics such as PCIe, InfiniBand, Fibre Channel, high-resolution digital video, Serial ATA, GigE, and SRIO. The VITA 41 standard is aimed more towards centralized switching applications with one or two dedicated switch boards in each chassis, whereas VITA 46 is more forward looking in its choice of connector fit by supporting very flexible fabric topologies including distributed or centralized switching models. Both VITA 41 and VITA 46 propose the use of four lane connections for these high-speed signals, such as four differential pairs in each direction.

But PCIe is not a switched fabric and, as a result, has limitations that become apparent when it is used to interconnect a number of SBCs across a backplane. To give PCIe full fabric capability, AS has been developed, with sophisticated switch designs incorporating additional packet-level functionality that can be used on new SBC designs in distributed or centrally switched fabric topologies.

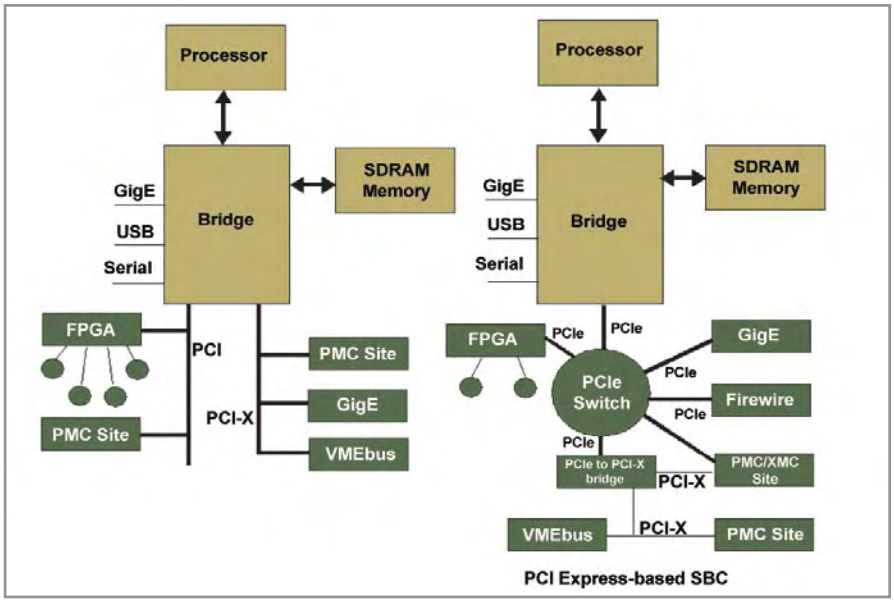

Figure 2

AS, derived from PCIe, uses the same physical and data link layers as PCIe but offers greater fabric performance than other architectures by including additional routing packets in the protocols. Enhanced switch designs use these protocols to effectively tunnel packets through the network from PCI device to PCI device directly. The benefits of AS for use in a multiprocessor SBC environment can be quickly summarized:

- AS supports distributed switching, allowing for systems of arbitrary size just using one common SBC element with four switch ports.

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PCIe alone does not support distributed switching, effectively limiting the system size to the number of switch ports integrated onto an SBC or else a centralized switch is required.
- AS provides a standard means for system discovery and configuration between peer end nodes through multiple bridges and switches.
- AS protocols, embedded by the AS fabric switches, provide an integrated solution to the requirements for buffer management, flow control, interrupt notification, DMA engines, error handling, and so on. These would require additional software support on native PCIe.
- AS supports multicasting.

A number of embedded SBC vendors, including Curtiss-Wright Controls Embedded Computing are committing to the support of AS as the fabric of choice for their future SBC offerings. Instead of the PCIe switch shown in Figure 2, a multiport AS switch would be used in which each of the supported local PCI devices is attached using PCIe and then, typically, four AS ports could be connected through to the backplane. This is illustrated in Figure 3.

This configuration of the SBC, which is complementary to the VITA 46 standard, allows many different connectivity options through the backplane:

- A number of similar SBCs could be hooked together in a fabric without the need for a centralized switch.
- A PMC carrier card incorporating a PCIe to PCI-X bridge could be used to extend the local I/O capability of one of the SBCs.
- A PMC module mounted on an SBC can be accessed by one of the other SBCs through the fabric.
- A video connection could provide data that may be shared amongst all or a selected number of the SBCs.

Don't forget the software

No interconnect strategy is complete without addressing the need for an effective software interface to communicate from processor to processor across a fabric such as AS when used in typical real-time military applications. Low-level transactions through a fabric would generally use a primitives library but this needs to be abstracted further from the intricacies of the hardware to provide a complete

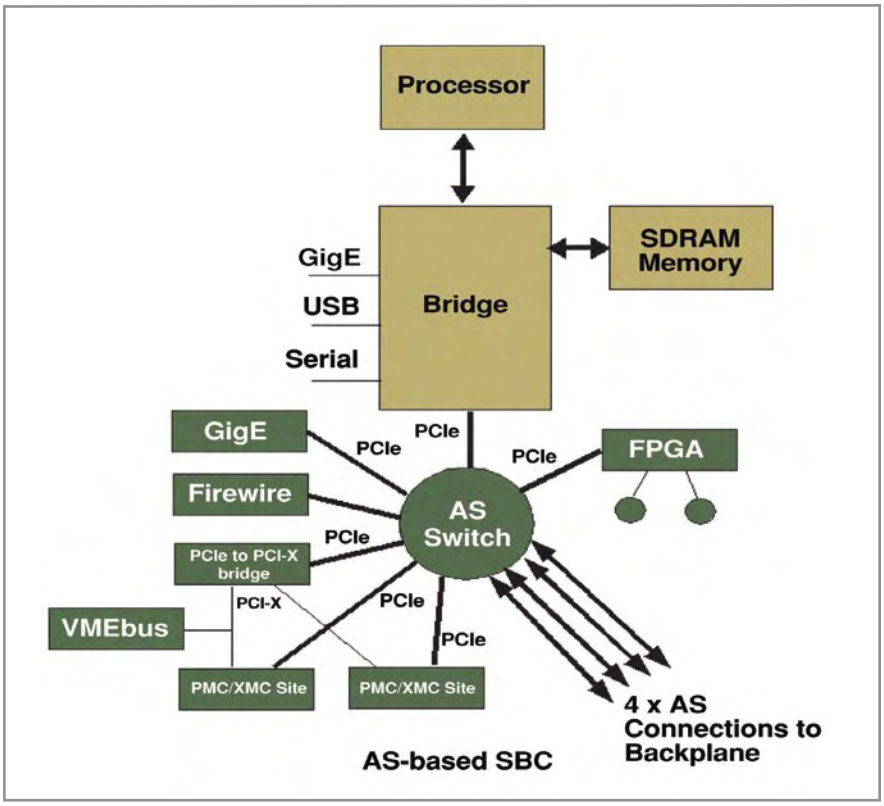

Figure 3

Applications Programming Interface (API) for the developer. In order to address this need, Curtiss-Wright developed their Inter-Processor Communications (IPC) software package for DSP applications initially based on StarFabric. Packages such as IPC will become fabric-agnostic, supporting StarFabric, AS, and SRIO transparently giving the user great flexibility in the configuration and mix of interconnect technologies used throughout the various parts of large and complex systems.

In order to maintain compatibility and allow for ongoing technology refresh programs to make best use of their existing infrastructure, the next generations of fabric-centric SBCs, based on PCIe and AS will retain their VMEbus connection through the backplane. While VME is rarely used as a data connection anymore, it is still widely used for interrupts and system management functions such as power-up Built-in Test (BIT) in multiprocessor systems. These SBCs, based on the VITA 46 standard and incorporating AS as the switched fabric, will have an integrated high performance interconnect offering multiple Gbps of off-card bandwidth to communicate with other SBCs, high-performance sensors, and display subsystems. They will provide the means to migrate from existing bus-based system architectures to new fabric architectures, using existing racking structures and cooling systems. Software packages such as IPC will abstract mixed architectures of DSP and SBCs with a common API to make the most of various future fabrics and interconnects.

For additional information on the Advanced Switching Interconnect SIG, visit www.asi-sig.org. For information on RapidIO, visit the RapidIO Industry Association at www.rapidio.org.

John Wemekanp *is chief technology officer for Curtiss-Wright Controls Embedded Computing Group (which acquired Dy 4 Systems in 2003). During his 22-year tenure at Dy 4 Systems, John filled a variety of roles beginning as hardware design engineer, and various management roles through to his current role at Curtiss-Wright as chief technology officer. Prior to joining Dy 4, John successfully led a team at Bell-Northern Research in the development of a telecommunications product. John holds a BS in electrical engineering from Queens University in Kingston, Ontario.*

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Is VXS ready for prime time?

By Jeff Bateman and Dave Barker

There has been considerable progress this year in the VITA 41 VXS (VME Switched Serial) arena, but is VXS to the point that OEMs and system integrators can actually use it in their next-generation system designs? The answer is a resounding "yes," although many of the switched serial fabrics are not as readily available as is required. The good news, however, is that FPGAs can substitute for in-development fabric ICs, and non-switch architectures can still use serial fabrics in direct, "switchless" interconnect schemes.

Created by the VMEbus International Trade Association, VITA standard 41 VME Switched Serial (VXS) defines a flexible multi-gigabit switched serial interconnect fabric extension for VME, capable of handling the huge real-time data transfer requirements of today's High Performance Embedded Computing (HPEC) applications. A major benefit of serial fabrics is increased bandwidth and bandwidth scaling. Adding more boards increases the total backplane bandwidth, instead of "maxing out" VME's limited maximum bandwidth.

The first half of 2005 has seen a number of VXS processing boards, IO modules, switch cards and backplane announcements from the COTS community; several of these boards are in or nearing production. In addition to commercial offerings, a number of OEMs and system integrators are developing their own proprietary boards based on the VXS specifications.

Not withstanding the maturity of the VITA 41 specifications and the number of product announcements, the VXS community still has some issues to sort out. Some of the biggest issues facing VXS product vendors and the user community are:

- The lack of a dominant fabric and the associated fragmentation within VXS
- Limited availability of crossbar switch silicon for most fabrics
- Fabric standards in a state of flux, exacerbating the silicon availability problem
- No fabric switch boards, with the exception of InfiniBand
- The cost and complexity of a switch board

These challenges are not unique to VXS. Other system architectures based on switched serial interconnects such as VITA 46 and PICMG's AdvancedTCA are struggling with the same issues.

> …smaller VXS solution vendors…can't risk betting on a fabric only to find out that they chose the wrong one.

No dominant fabric

The *fabric wars* – the battle for market share – have been "raging" (or simmering) for years, still with no clear winner in sight. However, some strong contenders have emerged, namely RapidIO, PCI Express (PCIe), and Advanced Switching Interconnect (ASI). There are also those who think that InfiniBand has a place in high-performance embedded computing. And, don't count out 10 GigE, although it's not a contender today. It is not clear if one of these fabrics will emerge as the "winner" and dominate VXS and other switched-serial-based solutions such as VITA 46 or AdvancedTCA.

Larger VXS solution vendors may be able to drive the adoption of their chosen fabric and foster the development of an ecosystem around a particular fabric. But, smaller VXS solution vendors may not be able to do so, and they can't risk betting on a fabric only to find out that they chose the wrong one. These smaller vendors need to keep their options open. One way they can do this is by using FPGAs in their VXS designs.

Moreover, it may be appropriate to mix fabric protocols within a system. For example, designers may wish to use a tuner board that uses InfiniBand, and a processor board that uses PCIe. FPGAs help overcome such hurdles.

Lack of fabric crossbar switch boards and silicon

There are still no commercial VXS switch boards available for PCIe, RapidIO, or ASI. Only InfiniBand has at least one product – the SBS IB4X-V41. InfiniBand switch chips are in volume production from Mellanox Technologies, however, there is still no switch chip available for ASI. Switch chips for PCIe, the PLX PEX8516 and PEX8532, are sampling today, but have yet to reach full production or release for board-level VXS products. Switch chips for RapidIO, the Tundra TSi564A and TSi568A, are in development, but will not be available in volume this year. With some fabric standards in flux, and early release silicon, incompatibilities remain a risk.

Does this mean that the only choices are to use InfiniBand or wait for availability of RapidIO, PCIe, or ASI commercial switch silicon and boards? Not necessarily. For companies wanting to build VXS solutions today, FPGAs can be utilized to implement switches or to implement simpler direct connections between boards in a VXS backplane.

Switch boards add cost and complexity

Even with the availability of VXS switch boards implementing the desired protocol, many applications cannot afford the additional cost and complexity that comes with a switch board, or may not have the space or power available to accommodate

one. Compact applications can be implemented with only two or three boards in the system. For example, a small VXS application illustrated in Figure 1 may consist of:

- An A/D converter board that receives data from a sensor and passes data to an FPGA-based DSP board
- A DSP board that performs some front-end processing before passing the data to an SBC
- An SBC board, often PowerPC- or x86-based, that performs some back-end processing and then passes the data to a network or graphics PMC/XMC board for display

Data simply flows in a *pipeline* from one VXS board to the next, which maps well to a switchless configuration implementing three backplane slots with direct serial interconnects (Figure 2). If additional communication paths are necessary – say between multiple DSP boards – a more complex infrastructure, mesh, ring, hypercube or others, must be implemented, but even in such situations a full message switching protocol can be overkill. Still, this type of architecture shows that switch boards are not always necessary.

FPGAs enable VXS today

With all of the issues that still need to be sorted out, how can companies implement VXS solutions today? One approach is using FPGAs. FPGAs with multi-gigabit serial connectivity offer a fast, reconfigurable, flexible solution, both for payload and switch boards. Key advantages are:

- Fabric protocol flexibility
- Applicability to both payload and switch boards
- Versatile switch configurations
- Simple bug fix/upgrade path, even for deployed units
- Solutions available today

Fabric protocol flexibility

FPGAs equipped with Multi-Gigabit Transceiver (MGT) serializer/deserializer links provide the raw transfer bandwidth necessary for VXS applications, and the flexibility desirable for surviving the ongoing standardization melee. Xilinx Virtex-II Pro, Virtex-4, and Altera Stratix families are examples of high-performance devices incorporating multiple MGTs, operating in the

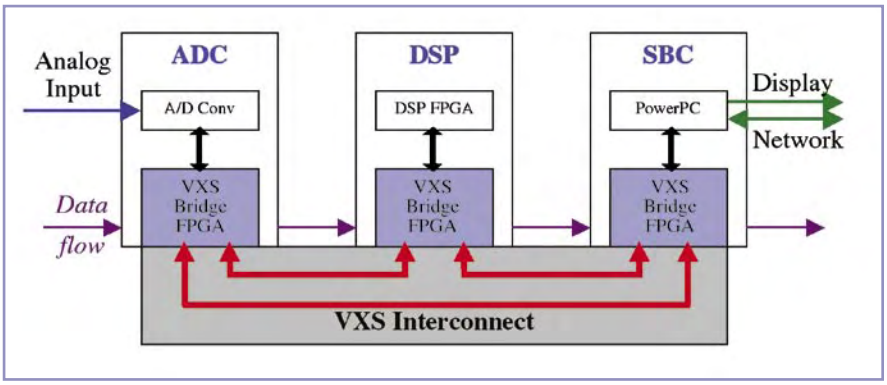

Figure 1

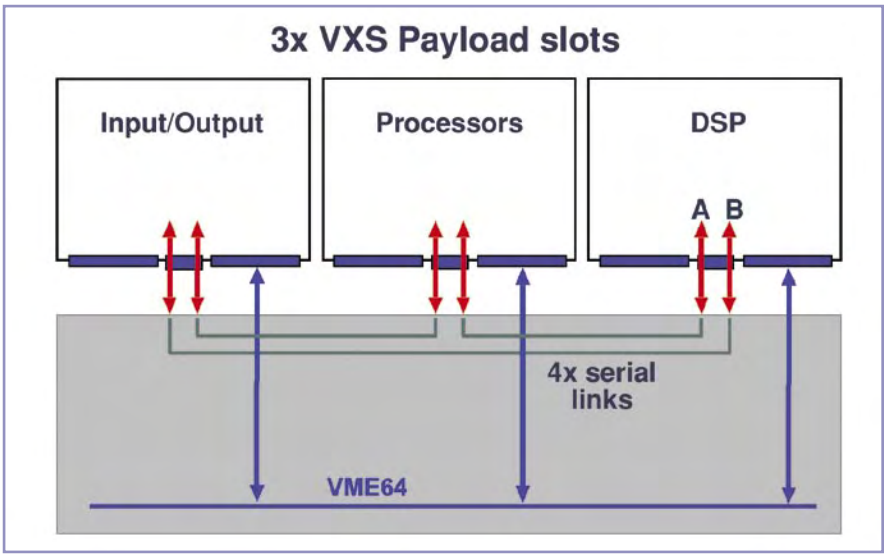

Figure 2

VXS backgrounder

VXS payload slots feature a new multi-gigabit P0 connector to add serial connectivity, while retaining compatibility with legacy boards through the traditional parallel VMEbus connectors. VXS backplanes route two 4x port backplane links from each payload board, either to one or more switch board slots or, in small systems with typically three payload boards or fewer, directly between nodes. VXS switch slots feature four multi-gigabit backplane connectors, supporting up to 24 4x port connections from payload slots and other switch slots. Switch boards plug into these slots to implement a crossbar switch between backplane ports.

Transport protocols define how to interpret raw data transported by the links. Packet routing protocols, such as InfiniBand and PCI Express, include network routing information within the packet so crossbar switches can automatically route packets. In contrast, simple low-overhead protocols such as Aurora just move data between two nodes through a single link, with no routing information required.

VXS consists of a base specification defining physical features of VXS components, coupled with a set of transport protocol layer standards to define the specific serial interconnect used in a system implementation (Table 1). For an in-depth look at VXS, refer to the VITA special issue of *VMEbus Systems* magazine, February 2005.

Spec	Description	Rev	Status
VITA 41.0	VITA 41 VXS base specification	1.11	In ANSI ballot
VITA 41.1	InfiniBand Protocol on VXS	1.9	In ANSI ballot
VITA 41.2	Serial RapidIO Protocol on VXS	1.9	In ANSI ballot
VITA 41.3	VXS 1000 Mbps Baseband IEEE 802.3 Protocol Layer	0.1	In ANSI ballot
VITA 41.4	VXS 4X PCI Express Protocol Layer Standard	0.2	In ANSI ballot
VITA 41.5	Protocol Specification: Aurora	N/A	Just begun
VITA 41.10	Live Insertion System Requirements for VITA 41 Boards	1.0	Draft
VITA 41.11	VXS Rear Transition Module Standard	0.6.2	In ANSI ballot

Table 1

SIDEBAR

622 Mbps to 10 Gbps range. FPGA vendors build much of the flexibility necessary to support various serial protocols right into the transceiver logic. Fortunately, the various serial standards usable with VXS have similar low-level characteristics for the physical connections, and direct FPGA-to-backplane connections are possible.

Individual channels can be bonded, ganged together, to transfer a data stream at higher speed, which is an important consideration since most VXS protocols use "4x" bonded ports. FPGAs can also include an on-chip processor – either a dedicated device such as a PowerPC 405 for Xilinx's Virtex-II Pro/Virtex-4 – or soft core such as Altera's NIOS core. With their close coupling to the transceivers, such processors are a good choice for off-loading protocol management from the system's main CPU(s).

Different serial fabric protocols are supported through a combination of configurable transceiver hardware parameters and IP cores residing in the gate array. Changing VXS protocols is, at least conceptually, simply a matter of changing the IP implementation used. With appropriate reconfiguration capability built into the system, implementing bug fixes or protocol enhancements within deployed systems is simplified.

Lightweight communication protocols, often using free IP, are perfect for implementing pipelined data flows in smaller systems. For example, Xilinx's Aurora core is designed primarily for short, low error rate, chip-to-chip connections. It covers the physical and link layer interfaces, but does not define error detection or recovery mechanisms, or a data switching/addressing scheme. Recently, the VITA Standards Organization (VSO) created a working group to develop an Aurora protocol specification, VITA 41.5.

For larger VXS systems more complex message switching protocols, such as RapidIO, PCIe, InfiniBand, Fibre Channel or ASI, simply require different firmware and software implementations within the same board-level hardware. FPGA and third-party IP vendors supply compliance-tested IP to allow confidence in proper protocol implementation.

Payload implementation

Using an FPGA to implement the VXS serial interconnects through the P0 connector on payload boards makes a lot of sense, especially in light of the current state of the switched fabrics. Many of the announced VXS payload boards use an FPGA to implement the VXS connections, such as the VPF1 from VMETRO (see Figure 3).

This approach provides considerable flexibility in backplane topologies. For example, it enables the payload boards to be directly connected, as illustrated previously in Figure 2, by implementing a point-to-point protocol such as Aurora in the FPGA. It also enables the same payload board to communicate with other boards via a switch board, as illustrated in Figure 1, by reprogramming the FPGA to support a switched serial fabric protocol. Being able to deploy the same hardware in systems using different fabric protocols is a very significant benefit. For example, the same DSP board could be used in Aurora, PCIe, or InfiniBand-based systems.

Switch implementation

Larger systems require more than three VXS payload slots. Each VXS payload slot has eight full-duplex links, usually configured as two ports, each of four bonded links. With two ports available per board, it is not possible to directly connect more than three boards to every other board; only a ring architecture is possible with four or more boards unless a switch is used.

Figure 4 illustrates a VXS switch slot in a star configuration. But it does not have to be a fixed protocol fabric switch. An FPGA-based switch board would provide a very flexible solution, albeit at a higher cost than a fixed-protocol switch. Connecting multiple protocols may be necessary until a fabric war victor emerges. That is: vendor A's ADC may

Figure 3

use InfiniBand, vendor B's SBC may use PCIe, vendor C's DSP may use serial RapidIO. Only an FPGA-based switch has the potential to bridge together such disparate hardware, although bridging between different protocols is certainly a significant engineering challenge.

Fortunately, typical signal processing systems have predictable data flows; so implementing full crossbar switching between all 96 serial channels (24 4x ports) present on each switch slot connector is rarely necessary. Several large, expensive FPGAs would be necessary to do so. A subset would suffice in many cases, for example, 14 4x ports per switch are sufficient to support Elma-Bustronic's current 12-slot VXS backplane, or ten 4x ports for an eight-slot VXS backplane. Those backplanes have two switch slots, with one port from each payload board connected to switch A, and the other to switch B. Two additional ports connect directly between switches A and B.

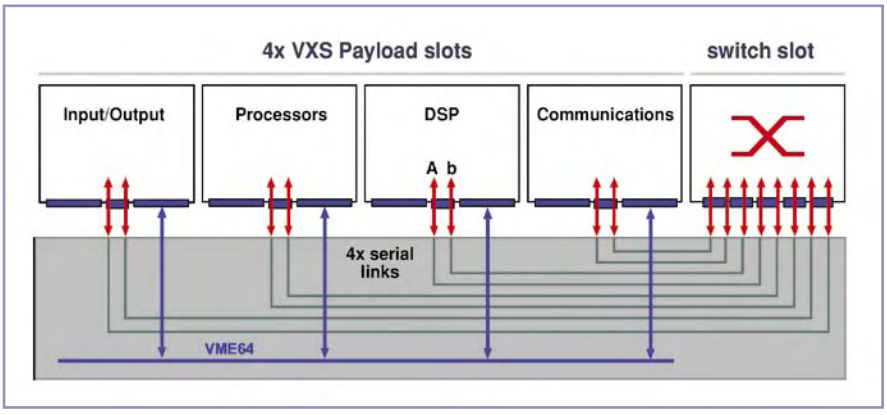

Figure 4

Backplane I/O and other VITA standards

VXS also preserves VME's traditional P2 rows A, C, D, and Z connections for generic user I/O. A new Rear Transition Module (RTM) format, VITA 41.11, enables high-speed I/O signals to be routed through a payload board's P0 connector to an RTM. This is ideal for housing fiber-optic transceivers or copper connectors when I/O cables must attach to the rear of a rack.

There are other VITA standards related to VITA 41. The standard VITA 42, or XMC, defines a new mezzanine format based on the popular PMC, essentially by adding high-speed serial connections as complementary or alternative connections to the traditional PCI bus. VITA 46 defines another implementation for high-speed serial fabrics in a Eurocard form factor, with more serial connectivity than VXS but without backward compatibility. Again, the lack of a dominant serial standard leads to multiple choices. For these standards, too, FPGAs protect against making the wrong choice and enhance board reusability.

Is VXS ready for prime time?

The answer is a resounding "yes." VXS is ready for prime time. Even with a lack of commercial switched serial fabric silicon, designers can take advantage of FPGA technology to create flexible VXS solutions that solve real-world problems today. FPGA-based VXS solutions, such as VMETRO's VPF1 are available today, which provide the flexibility and configurability that enables customers to create working VXS systems. When the switched fabric technologies mature, or the fabric war is won, these same FPGA-based solutions can be reprogrammed to support the fabric of choice. OEMs and system integrators are successfully building solutions today because of the maturity of the VXS specifications and the availability of VXS building blocks. Ω

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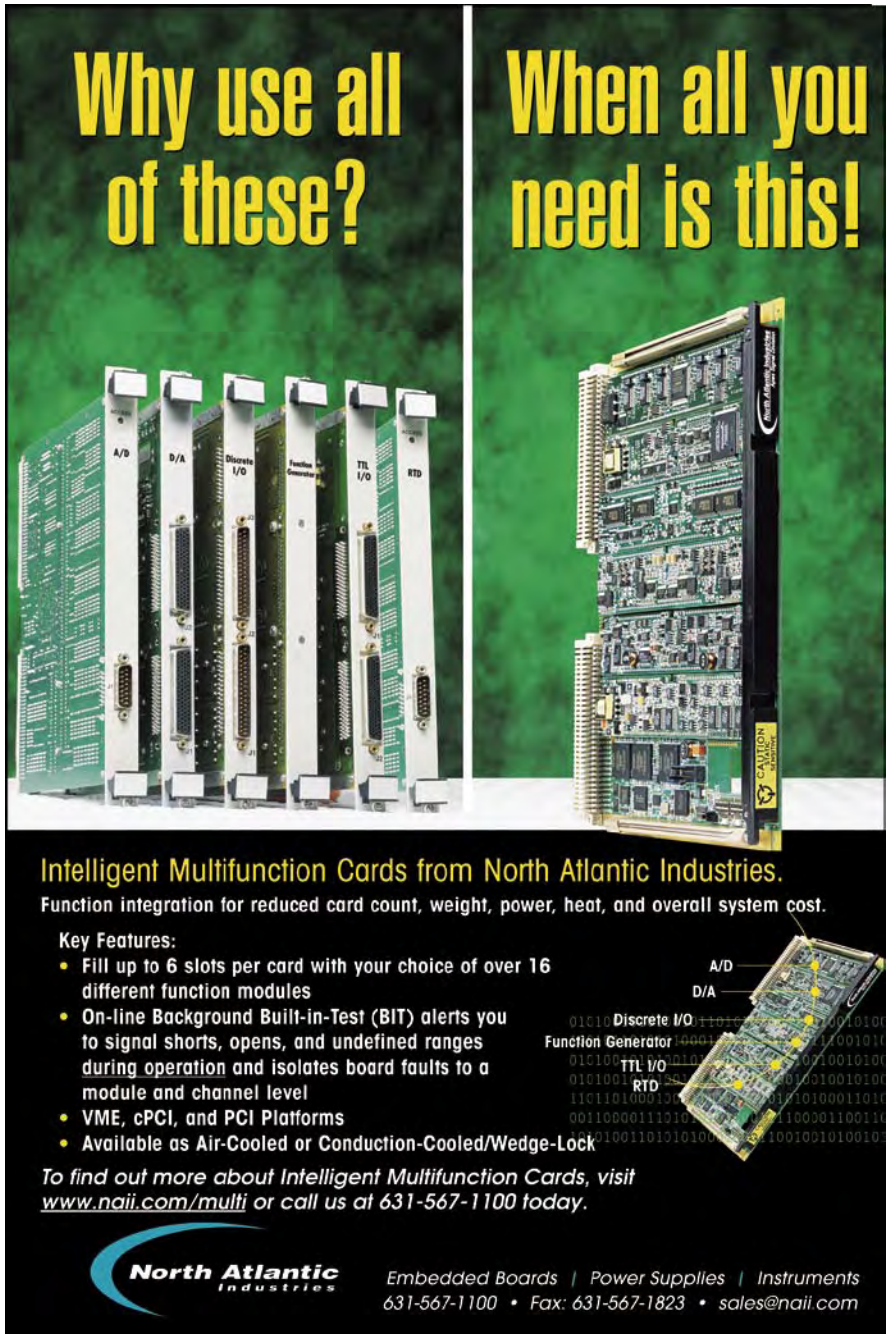
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Making the right choice: VME64x, VXS, VITA 46, and VITA 48

By Jing Kwok

Approaching its 25-year anniversary, the venerable VMEbus continues to evolve to meet the needs of current- and future-generation systems. Choices include VITA 41, with its ability to mix and match VME32/VME64 and switched fabric interconnects; VITA 46, which replaces the parallel bus with hundreds of pins of multi-gigabit serial I/O; and VITA 48, which adds capabilities for two-level maintenance and liquid cooling.

As the demands of new embedded defense and aerospace applications emerge, requiring ever greater bandwidth and advanced cooling technologies, the VMEbus International Trade Association (VITA) has responded by developing new board architecture standards designed to address these new challenges. Three of the most important new standards are VITA 41 VMEbus Switched Serial Standard (VXS), VITA 46, and its related standard, the VITA 48 Enhanced Ruggedized Design Implementation (ERDI).

To help system designers understand the distinct advantages and very real differences between these new standards, it is useful to compare their various attributes and highlight the problems each of these new standards is intended to solve. The key technology differentiators that a system designer must consider when choosing a system architecture include:

- Physical environment
- Processing needs and internal system bandwidth
- External system bandwidth and interconnects
- Conserving past investment and future proofing
- Technology availability and cost

In this overview, we will especially focus on the backplane interconnect. Because the fundamental specification VME64x remains an important technology that will be with us for many years to come, we will also examine how to build a VXS, VITA 46, and VITA 48 system and bridge it to VME64x.

Popular VME

All three of the new standards mentioned above have been designed to guarantee forward compatibility with older board generations. This feature enables designers to protect previous investment made in boards and software.

Today, VMEbus technology is used in a wide variety of application areas including:

- Imaging (medical, military)
- Industrial Control
- Video Processing
- Simulators (Flight, Missile)
- RADAR/SONAR
- Electronic Intelligence
- Mission Computer
- Telephony

Within each of these application areas, there can be disparate requirements. A RADAR system might be located in an air-conditioned environment or in the front end of a fighter jet. A mission computer might simply collect and record input from multiple 1553 interfaces or it might be tasked with receiving multiple Forward Looking InfraRed (FLIR) images, which it then analyzes and displays on multiple display heads. A telephony system might require that all I/O be available from the front of the card to enable back-to-back mounting of equipment bays, or it might require all I/O routed to the backplane to maintain an uncluttered faceplate to aid in quick identification and faulty card replacement, hence reducing the Mean Time To Repair (MTTR).

In systems where the environment is air conditioned or benign, the standard air-cooled 1101.10 mechanical standard is used. However, in more hostile environments such as the front end of a fighter jet the conduction cooled standard 1101.2 is used.

In systems where the internal bandwidth requirement is low, the standard VMEbus provides an adequate solution. However, when data plane bandwidths are higher, such as in a system with multiple video displays, or when there is a high compute load and data needs to be shared between multiple processors, a secondary data plane bus such as RACEway, StarFabric, or SKYChannel can be added to the J2 connector of VMEbus boards to provide extra bandwidth. However, this uses up pins on the backplane that could otherwise be used for I/O such as PMC I/O, 1553, serial channels, GigE, and a plethora of other I/O standards. Unfortunutely, there is no standard mechanical form factor or backplane for the system designer to use with these multiple secondary buses.

The VITA 41, VITA 46, and VITA 48 standards were developed to address these design challenges. However, each applies a different focus to solving the I/O problem.

VITA 41

VITA 41 was developed to address the need for a standard high-speed data bus and to provide interconnectivity for the next generation of high-speed serial interconnect silicon, including 10 GigE, Serial RapidIO, PCI Express, and Advanced Switching Interconnect. The common attribute among these serial standards is that they all run above 2 Gbps. At this speed, the standard VMEbus connector is not able to support these high bandwidth rates.

VITA 41 also specifically addresses the need for legacy VMEbus boards to be compatible with legacy VME hardware. While the VITA 41 backplane uses the same J1 and J2 connectors as a traditional VMEbus, it changes the J0 connector to the seven-row RT2 connector from Tyco. The RT2 connector is a high-speed differential connector, offering 30 differential pairs, of which 16 pairs are defined for high speed interconnect. Of the other pins on J0, one pin is defined to support live insertion, and the other pins are Reserved for Future Use (RFU).

A centralized switching scheme is used to communicate between VITA 41 cards. The 16 pairs of differential signals are assigned as two bidirectional four-lane serial ports. Each port connects to one of the two centralized switching cards in a VITA 41 backplane, shown as having 20 slots in Figure 1 (other slot counts can be created). This provides a redundant communication path between VITA 41 cards should one of the centralized switch modules fail.

Alternatively, vendors may choose to supply VITA 41 cards in a custom backplane. This would typically occur when the application needs a much higher bandwidth than the currently available 2 Gbaud on the legacy VMEbus P0 connector.

VITA 46

The VITA 46 standard takes a similar but different approach to solving the bandwidth problem (see Figure 2). It is similar in that it uses the RT2 connector; however, it uses the RT2 for all connector positions, hence allowing all connectors to support

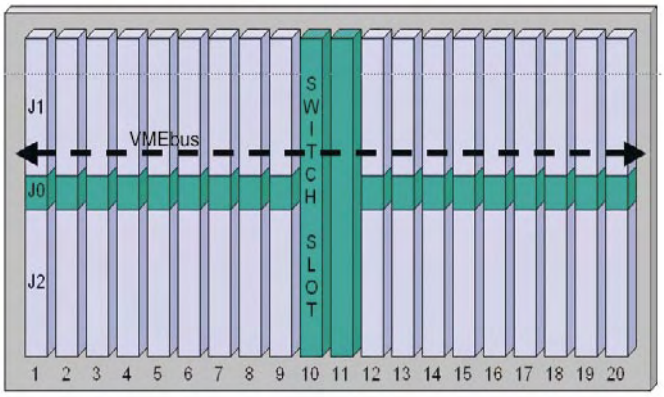

Figure 1

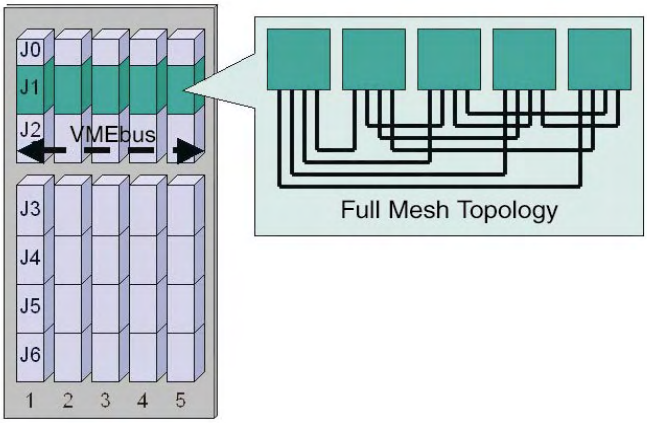

Figure 2

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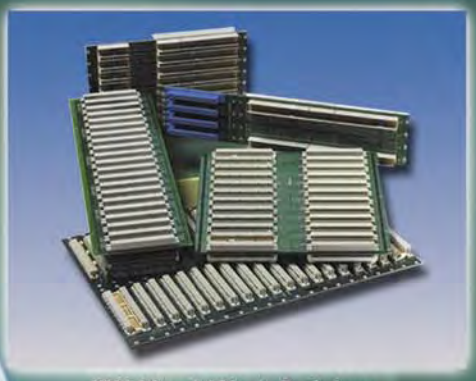

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high-speed differential signals. The VITA 46 standard defines 32 differential I/O pairs on J2 for its fabric instead of the 16 pairs in VITA 41.

This set-up provides some interesting capabilities. While VITA 41 is designed for dual redundant centralized switching, VITA 46 enables the system designer to design a distributed full-mesh switching system, which in itself is inherently redundant, since no single failed path or module will bring down the system. Figure 2 shows four ports of four lanes connected to each module. Each port is capable of 2.5 GBps of bidirectional bandwidth when each lane is run at 3.125 Gbaud (there is a 20 percent overhead due to 8B/10B encoding). The benefit of a full mesh is that more compact and space-efficient systems can be built since the two centralized switching slots found in VITA 41 are not required.

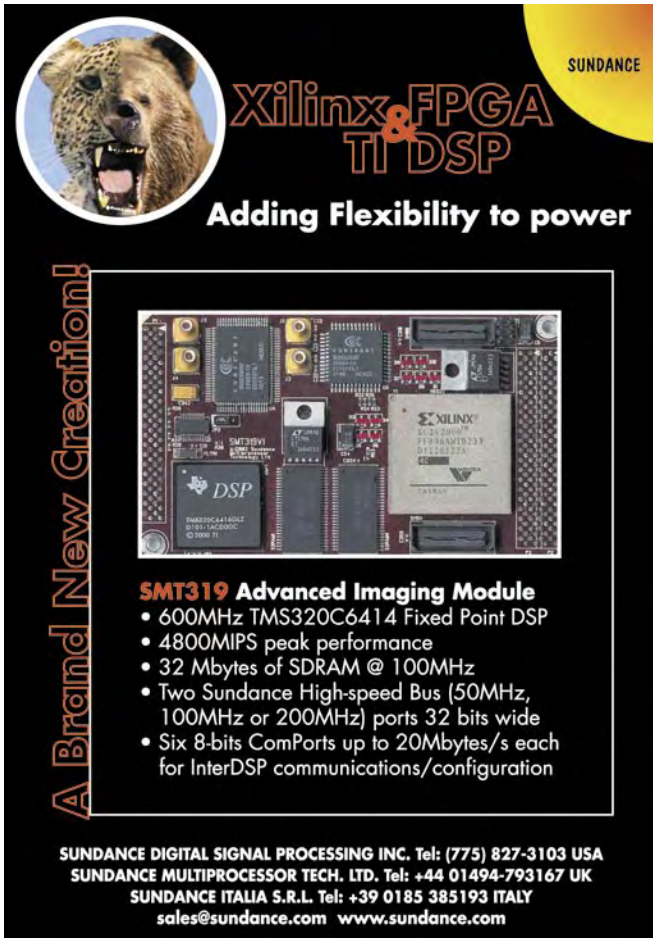
In its approach to improving the bandwidth capabilities of VMEbus modules, VITA 41 replaces the VMEbus J0 connector with the high-speed differential RT2 connector. However, this results in a significantly reduced number of user I/O pins, from 205 to 110. VITA 46 solves this by replacing the VMEbus J0 and J1 connector with all RT2 connectors, as shown in Figure 2. There are some significant advantages of doing this. The most important advantage is that with VITA 46, user I/O count increases from the VITA 41's110 pins to 272 pins. Even better, 256 of the 272 pins can be defined as high-speed differential pairs, each capable of 10 Gbps data rates. To take advantage of these additional user I/O pins, a standard mapping for XMC and PMC user I/O has been defined by VITA 46.9 (XMC and PMC User I/O Mapping for VITA 46).

Another advantage that VITA 46 offers over VITA 41 is that one of the VITA 46 connectors, P0, is designated as the utility connector. The utility connector carries power, maintenance bus, and test bus connections into the system. Voltages supplied are:

- 48 V @ 16 A or 12 V @ 32 A intended for primary power for high power cards
- 5 V @ 16 A intended for primary power for lower power cards
- +12 V @ 2 A intended for analog and PMC voltage
- –12 V @ 2 A intended for analog and PMC voltage
- 3.3 V @ 2 A used as auxiliary power

Forward compatibility

The combined benefits of a more slot efficient system and a greater user I/O count also result in a different solution to the forward compatibility requirement. Both VITA 41 and VITA 46 require a new system backplane. VITA 41 allows traditional VME cards that do not use the legacy VMEbus J0 connector to be plugged into the new VITA 41 backplane: communication to the legacy VMEbus cards is via the standard J1 and J2 connectors, which are identical in both standards.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In comparison, VITA 46 uses a hybrid backplane to enable legacy VMEbus cards to be plugged into the system. Figure 3 shows a hybrid setup with five legacy slots and five VITA 46 slots. On the VITA 46 hybrid backplane, communication between VITA 46 connectors and the legacy VMEbus follows VITA 46.1 (VMEbus Signal Mapping for VITA 46).

While a VITA 41 backplane provides compatibility for legacy cards without a VMEbus J0 connector, a hybrid backplane must be used to connect legacy VMEbus modules to VITA 41 modules if the legacy card uses the J0 connector.

3U VITA 46

The higher pin count on the VITA 46 backplane also provides benefits to small and space limited systems. Legacy 3U VMEbus systems did not provide any backplane user I/O. The VITA 46 standard provides the system designer a 3U solution by giving the designer a full mesh topology on J1 and allowing the user to use J2 as user I/O when a VMEbus is not defined for use in this area. This solution gives the user the ability to have 72 user IO pins when an RT2 differential connector is used on P2.

VITA 48

VITA 48 is essentially a mechanical standard that provides yet another level of capability above the VITA 46 standard. It uses the same connectors as defined in VITA 46 and provides all the same bandwidth and user I/O benefits. In addition, VITA 48 provides

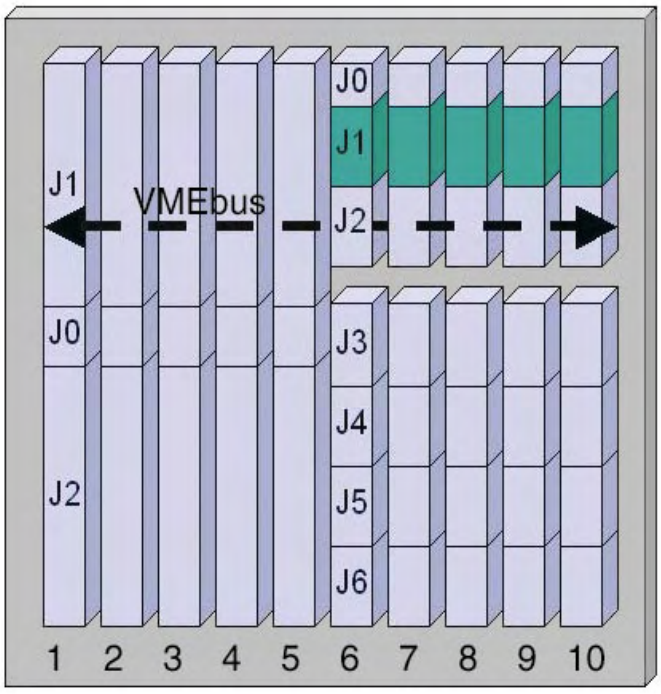

Figure 3

standards for two-level maintenance by utilizing covers to protect the module electronics. It also defines methods for advanced cooling techniques such as Liquid Flow Through (LFT) cooling.

In order to achieve these benefits, the VITA 48 standard defines the slot pitch of each module to be 1" (increased from 0.8"). Forward compatibility is supported by allowing VITA 46 modules to be plugged into a VITA 48 backplane and chassis.

Summary of tough choices

Each of these three new emerging standards has its niche in solving different system requirements. Table 1 tabulates these attributes.

VMEbus is well suited for systems with lower internal system bandwidths. It will continue to solve problems for many years to come.

VITA 41 is suited for systems with higher internal bandwidths where high numbers of backplane I/O is not required and larger physical system space is not an issue. These systems typically use front-panel I/O.

VITA 46 is suitable for high internal and backplane bandwidth where a high number of user I/O pins is required on the backplane. VITA 46 is well suited for applications where the physical size of the system is constrained. 3U VITA 46 offers user I/O on the backplane whereas VITA 41 and VMEbus does not.

VITA 48 is also suitable for high internal and backplane bandwidth where a high number of user I/O pins is required. However, its distinguishing attribute is that it provides cooling mechanisms for high power boards via liquid flow through cooling. Ω

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Attribute	VME64x	VITA 41	VITA 46	VITA 48
Standard bandwidth	VME: 320 MBps	VME: 320 MBps 16 serial pairs for 5GBps @ 3.125 gbaud	VME: 320 MBps 32 serial pairs for 10GBps @ 3.125 gbaud 30GBps @ 10 gbaud	VME: 320MB/s 32 serial pairs for 10GBps @ 3.125 gbaud 30GBps @ 10 gbaud
Switch Fabric	N/A	Centralized switching	Mesh or Central	Mesh or Central
Faceplate user I/O	Yes	Yes	Yes	Yes
Backplane user I/O	205 pins	110 pins + 32 pins for fabric + 31 pins RFU (future use)	272 pins + 64 pins for fabric	272 pins + 64 pins for fabric
User I/O for 3U system	0	0	J2 72 pins	J2 72 pins
Backplane I/O bandwidth	205 @ 1 gbaud	110 @ 1 gbaud 16 pairs @ 10 gbaud	160 pairs @ 10 gbaud	160 pairs @ 10 gbaud
Defined differential X/PMC I/O mapping	No	No	Yes	Yes
Existing VME64x cards forward compatible	Yes	Yes for VME cards without VME64x P0, use Hybrid otherwise	Yes Use Hybrid backplane	Yes Use Hybrid backplane
Slot pitch	0.8"	0.8"	0.8"	1"
Available Power	5 V: 90 W 3.3 V: 66 W		5 V: 80 W 12 V: 384 W or 48 V : 768 W	5 V: 80 W 12 V: 384 W or 48 V: 768 W
Cooling	Air, conduction	Air, conduction	Air, conduction	Air, conduction, liquid flow through

Table 1

Jing Kwok *is principal engineer in the Technology Group at Curtiss-Wright Controls Embedded Computing. He has been involved with VMEbus standards work for the past 15 years. He is editor of one of the VITA 46 "dot" specifications now in working group ballot and was one of the chapter editors for the VME64 specification. Jing is a graduate of British Columbia Institute of Technology.*

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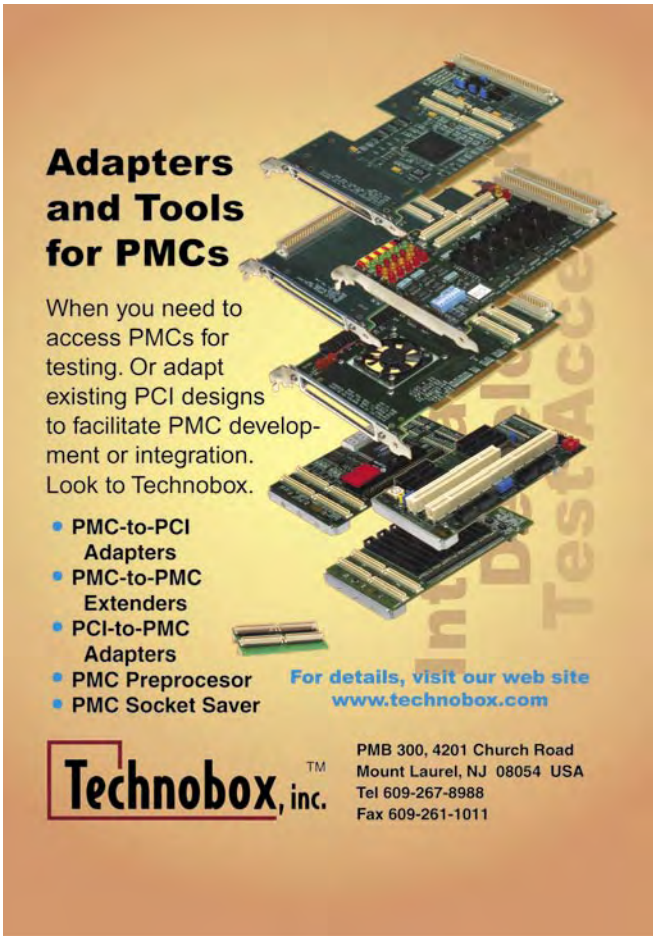
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FPGAs are the best choice to ride the PCI Express wave

By Abhijit Athavale

As the desktop and embedded worlds move beyond PCI and PCI-X to PCI Express, FPGAs can bridge between legacy buses and PCI Express. Additionally, since FPGAs are flexible enough to realize all kinds of logic elements – including PCI Express interfaces and intelligent peripherals – the FPGA allows a "one size fits all" implementation. Cost can be saved, as well as time to market and time in market.

The surge of PCI Express as a "big player technology" in the personal computer and server space is a given. Similarly, its formidable adoption in the embedded space will ultimately be driven by programmable logic. Why? While a number of standard PCI Express chips are available, FPGAs, with their flexibility and risk reduction benefits, enable embedded designers to implement products that can be differentiated from the competition. FPGAs also significantly reduce supply chain costs, translating into lower system cost. Ultimately, designers are able to design and get PCI Express products out to market early, which translates to better profits and more time in market.

Challenges for embedded designers

Embedded designs are usually one of a kind and generally do not rely 100 percent on a standard architecture or specification. Embedded designers will typically add their own "secret sauce" to an existing standards specification such as PCI Express to create a solution that can be differentiated from the competition. To this end, standard off-the-shelf products such as PCI Express switches and root complexes are used wherever possible to reduce costs, but key functionality, such as protocol bridging and traffic management, will always be implemented in custom logic via ASICs or FPGAs.

The availability of PCI Express in an FPGA gives designers the ability to create a design that exactly matches their requirements rather than shoehorning an existing product. For example, a designer could easily create a protocol converter using an FPGA to bridge a MIPS processor supporting HyperTransport to a PCI Express switch. The switch, in turn, would then talk to the low-cost, PCI Express-equipped peripherals versus more expensive HyperTransport peripherals.

In addition, in this day and age of profit margin squeeze, another requirement for the designer is to reduce total system cost to protect profits. Several factors add to the total cost of the system. These include:

- Costs in managing the supply chain
  - Inventory costs
  - Product qualification costs
- Costs associated with design and manufacturing
  - Mask costs
  - Silicon respins
  - Assembly

There are also indirect costs associated with time to market and time in market. That is, the quicker a product gets to market and the longer it stays in the market has a sizable impact on a company's top and bottom lines.

Even though reprogrammability, fastest time to market, and longest time in market are the biggest value propositions of the FPGA, reducing total system cost is another big advantage that is sometimes overlooked. One of the major advantages of using PCI Express components is their low cost comparable to PCI. Additionally, FPGA-based PCI Express implementations can drive the use of cheap PCI Express standard products into the embedded space nicely. This enables customers to reduce costs while matching market demand peaks and valleys.

The hidden cost of the supply chain

As PCI Express volumes start expanding, companies will have the flexibility to purchase chipsets, peripherals, processors, and DSPs from multiple vendors to get the lowest possible per-unit price. However, such an approach can make supply chain costs balloon to unmanageable proportions, especially when lower cost is the key.

Systems companies typically used to maintain a large supplier base to service myriad different designs using multiple types of semiconductors, cables, connectors, backplanes, and chassis. This approach gave complete flexibility to the engineering teams as they could choose the most optimal parts to design their system. However, this added complexity and cost to running the business. When business is good, it is easy to overlook such costs, but during lean times, the supply chain needs to be simplified by purchasing from fewer, but stable, top tier vendors.

Companies also typically kept a large quantity of supplier products on their shelves. The cost of carrying such goods can run into millions of dollars per day due to a number of factors such as component price declines and product obsolescence. Prices for components such as chipsets can decline 40-50 percent during their life, and the penalty for carrying overpriced components can be enormous. During 2001, many companies took an excessive inventory reduction write-off amounting to billions of dollars. As they moved from supporting one standard to the other, holding any components in stock for older standards was completely useless. Using the HyperTransport example above, if a company decided to move from the declining HyperTransport standard to PCI Express,

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an FPGA-based PCI Express implementation would be the only choice to deal with a HyperTransport-equipped MIPS processor.

In addition, having too many suppliers means that a large amount of money and time has to be dedicated to qualifying multiple parts. For example, if PCI Express peripherals from three different vendors were purchased, each product is likely to have different design requirements. Designing with different chips translates to differing hardware requirements such as PCB design guidelines, power supplies, and software/firmware requirements. Hardware and software testing and debug cycles must be applied to every part. The company's test documents must also be applied differently to different parts, since a common specification will not work. On the other hand, using an FPGA as a PCI Express peripheral means that only one product qualification flow is required. As soon as the FPGA is qualified, any designer is free to use it.

FPGAs offer the best solution for embedded designers

FPGAs are often the right choice for any company eager to benefit from the lower costs associated with PCI Express. While the basic value proposition of an FPGA and risk reduction over ASICs and standard products is still the same, the newest FPGAs are making significant gains on the performance, density, and power fronts. In addition, all major FPGA vendors offer very cost-competitive price reduction paths for the production volumes required by such applications. This trend is evident by the declining ASIC starts vs. increasing FPGA starts (Figure 1).

In addition, FPGA vendors are large companies with excellent balance sheets, and customers can rest assured that the supply will continue for a long time without interruption. The flexibility of the FPGA means that designers are essentially using the same die for a number of different products. Once the FPGA is qualified, having a single part serve in multiple applications enables designers to reduce the number of SKU codes and inventory lines they have to manage. For example, using an FPGA as the design platform, in lieu of separate PCI Express devices, makes possible

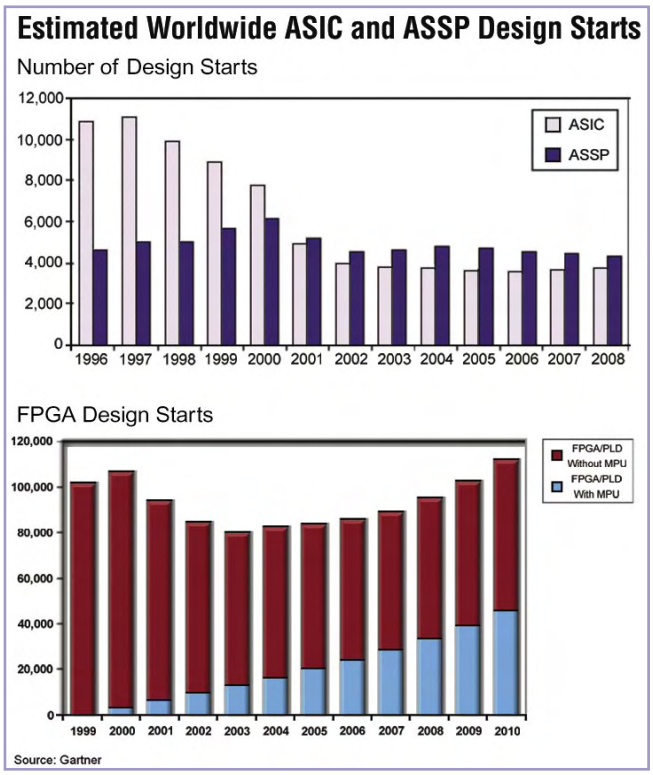
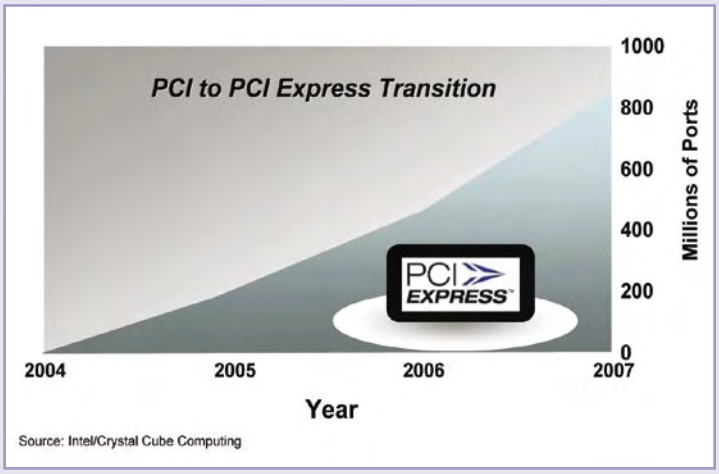


Figure 1

VME I/O OPTIONS

Transitioning from PCI to PCI Express

As the industry transitions from traditional, bus-based shared I/O schemes with system synchronous clocking such as PCI, serial point-to-point system interconnects using clock-data recovery techniques are fast becoming the norm. PCI has been the most widely used bus standard in the PC, server, and embedded market for the past decade. PCI Express is widely seen as the future of PCI, having a very wide appeal across industry segments. In fact, it is estimated that PCI Express will replace 80 percent of all existing PCI ports by the end of 2007 (Figure 1).



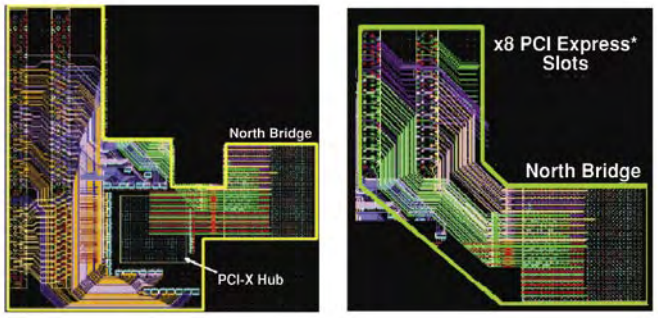
Sidebar Figure 1

PCI Express is a high-speed serial I/O technology that uses a Clock Data Recovery (CDR) technique. Instead of using a system synchronous or source synchronous clock, the clock is embedded into the data stream and recovered at the receiver. In general, serial I/Os reduce pin count, thereby reducing the number of traces, size, and number of layers on the PC Board (PCB). Figure 2 shows a board area reduction of 53 percent when switching from PCI-X to PCI Express. This, in turn, simplifies the layout and design of PCBs.

Fewer pins also translate into reduced noise and EMI. CDR eliminates the clock-to-data skew problem prevalent in wide parallel buses, and interconnect implementation is easier. All these advantages add up to smaller and thinner PCBs, easier layout, smaller enclosures, and reduced cooling requirements. Combined together, they mean significant savings for the customer.

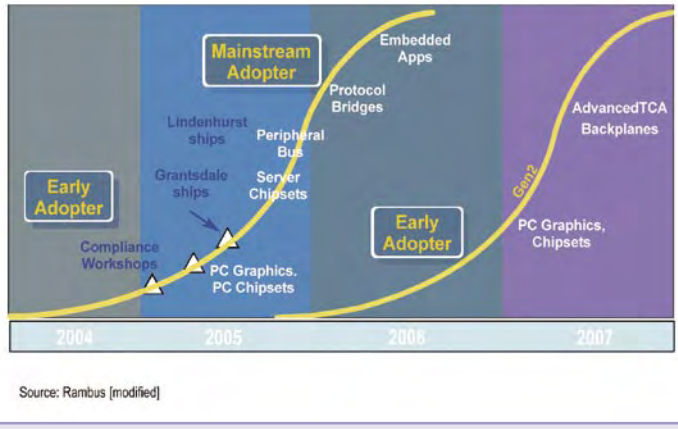
The initial PCI Express-based standard products such as chipsets, graphics processors, and switches are available now. PCs and servers that use these products are already in, or close

SIDEBAR



Sidebar Figure 2

to, volume production now. Also available are FPGA-based PCI Express implementations, which marry an FPGA such as Virtex-4 from Xilinx with IP cores. While standard-product chip manufacturers and early adopters generally use these as prototyping vehicles, such implementations are key to making any technology successful in the embedded markets such as communications, storage, industrial, medical, and others. This matches very well with the projected mass scale adoption of PCI Express into the embedded space around 2006 (Figure 3).



Sidebar Figure 3

A real-world case study design example showing how the total cost of ownership is reduced with programmable logic is explained on page 36.

the design of one PCI Express add-in card that can run in multiple applications with just a bit stream change. The savings in inventory and qualification costs is significant.

Another advantage that the FPGA offers is instant gratification. Specifically, the designer gets to buy off-the-shelf parts with no long lead times, download their design into the device, and see if it works. If it does not, they can rev the design and see if it works. While the entire process is not this simplistic, and the designer must still do extensive simulations for designs such as PCI Express root complexes, the entire exercise can be repeated multiple times rather than waiting for six to nine months for the first silicon. Complex IP cores that enable such designs are now available from third-party IP vendors for FPGAs as well as ASICs. Ω

Abhijit Athavale *is the worldwide marketing manager for Xilinx Connectivity Solutions. His responsibilities include strategy development, product positioning, and marketing program development for the company's high-speed serial and parallel connectivity offerings. Abhijit has also held other positions in marketing, as well as applications and software engineering since joining Xilinx in 1995. Previously, Abhijit was an R & D engineer designing communications products at Meltron. He received his bachelor's degree in electrical engineering from the University of Pune in India, and master's degree in electrical engineering from Texas A & M University. Abhijit is an accomplished speaker and author of several published papers.*

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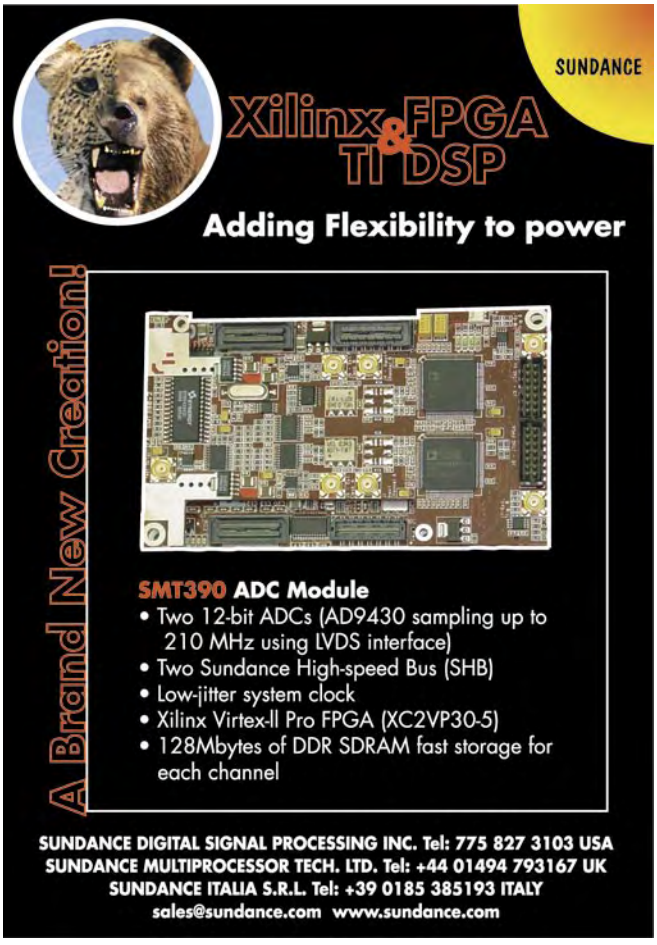
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Reducing total cost of ownership with programmable logic

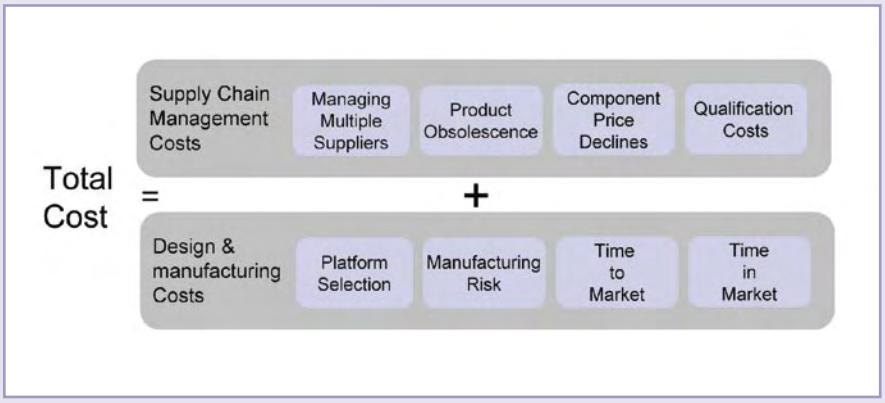
It is apparent that FPGAs offer a total cost of ownership (Figure 1) advantage compared to ASICs or ASSPs for most embedded applications. FPGAs help designers manage costs through their flexibility and ability to reduce total system cost. Programmable logic eliminates excessive supply chain costs associated with inventory, too many suppliers, and qualification. In addition, the risk reduction benefits and continuously improving performance, along with the ability to offer instant gratification to the designer, cannot be overlooked.

Programmable logic is not just great for early adopters implementing the PCI Express standard for the first time, but it also makes a lot of sense for companies taking their systems to production. Looking at a real-world case study design example illustrates this point further (Figure 2).

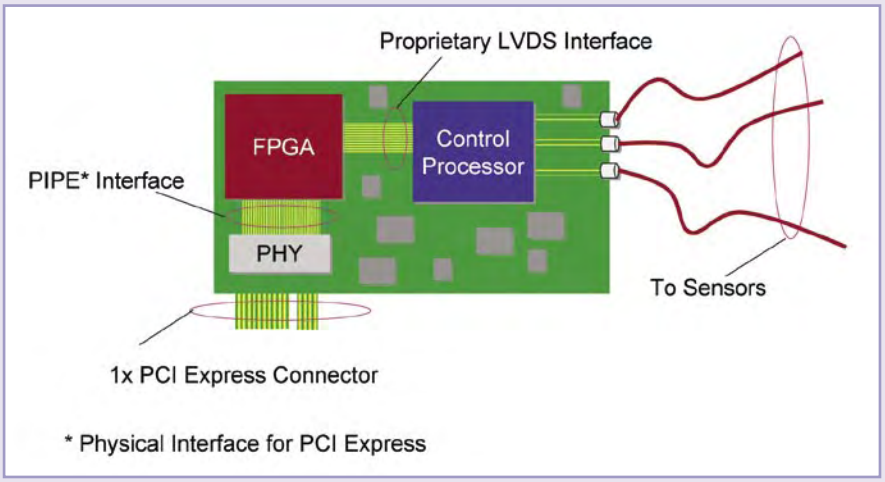
Case study application: Proprietary PCI Express data acquisition add-in card

Requirements: A single lane, fully complaint PCI Express-based controller card. The controller should also interface to a control processor on the user side with a proprietary LVDS interface. Sensors connect to the control processor through the back panel. Production volume: 25 K units per year for three years.

The designer had an option to choose between two solutions:



Sidebar Figure 1



Sidebar Figure 2

Solution 1

Two-chip solution: A PCI Express to PCI bridge ASSP, and an FPGA to bridge from PCI to the proprietary interface with custom logic.

Total cost:
3 × 25,000 × $22* = $1,650,000
*(ASSP $15 + 90 nm FPGA $7 + NRE $0)

Solution 2

Two-chip solution: A PCI Express PHY device with PIPE[1] interface and an FPGA to bridge PIPE to a proprietary interface with custom logic.

Total cost:
3 × 25,000 × $15* = $1,125,000
*(ASSP PHY $5 + 90 nm FPGA $10 + NRE $0)

Solution 3

Single-chip solution: An ASIC PCI Express to proprietary interface bridge with custom logic.

Total cost:
3 × 25,000 × $7* + NRE $600,000 = $1,125,000
*(ASIC)

The designer chose the second solution because it offered the best price and flexibility. While Solution 3 offered a single-chip solution, it was fabricated on an older process, and the production silicon wouldn't be available for approximately six months. In contrast, the designer was able to order the FPGA and implement their design right away, completing the final design in three weeks. The final product shipped in only two months. There was also little risk associated with the FPGA design. The FPGA had already been qualified by the designer, so there was no additional cost or time associated with that step.

Reference

[1] PIPE: Physical Interface for PCI Express. This is a specification developed by Intel that defines the PHY-MAC interface for PCI Express. PIPE uses SSTL2 signaling and has a databus that can run 8-bits wide at 250 MHz or 16-bits wide at 125 MHz.

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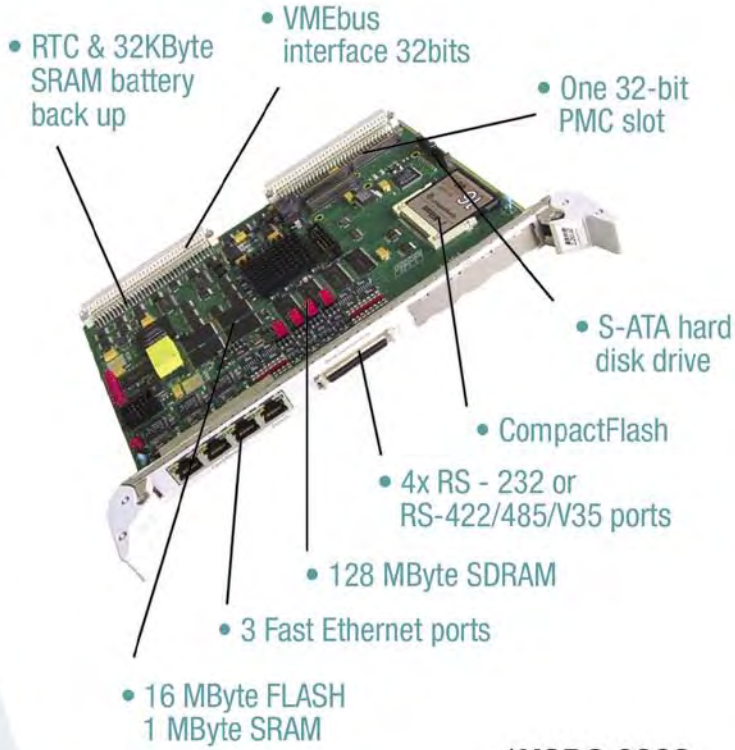
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What is happening with VXI?

By Grant Drenkow

While there are newer test and measurement standards such as PXI and LXI, nothing beats VXI at aggregating lots of high-performance I/O or deploying in rugged field service. However, as newer and more cost-effective standards proliferate, VXI will comfortably survive by being bridged and integrated into modular T & M systems.

It's hard to believe that VXI is coming up on its 18th birthday. Developed by five companies in 1987, VXI has been used in aerospace/defense, satellite, automotive, telecommunications, medical, and industrial electronics applications. From its peak sales of $850 million in 2000, VXI declined during the economic downturn but made a comeback in 2003 and 2004, according to analysts at Prime Data VXI Reports.

Success…and status quo

VXI users are very loyal to the platform, not finding benefits easily replicated by bench instruments or smaller modular formats like PXI. VXI modules come in a variety of Eurocard sizes ranging from 3U to the very large 9U (Figure 1). Users can mix and match high-performance instruments, high-density switches, and high-speed data acquisition modules in a very compact space. Mass interconnect panels enable users to attach and detach hundreds of wires in seconds as shown in Figure 2. Built-in trigger buses synchronize multiple modules without additional wiring. In addition, the VXI communications bus has increased in speed from its original 40 MBps to the latest revision with a backplane speed of 160 MBps.

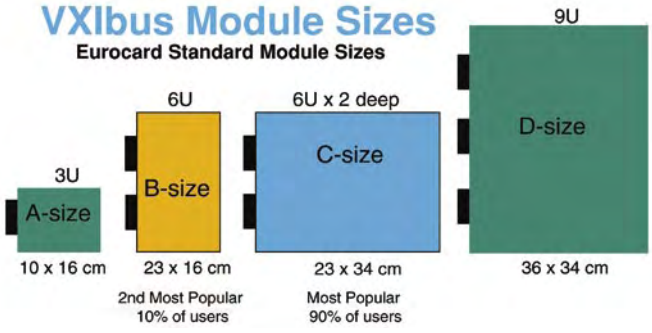

Figure 1

Figure 2

VXI hasn't taken over the test industry, however. Why? First, not every test instrument is available in VXI. Although T&M companies put many of their popular products in VXI, other products were only available in instrument form. Second, VXI has overhead costs – for example, card cage, Slot 0, and MXI link – that cause engineers to use it in large applications where they can fill up the card cage (refer back to Figure 2). For applications that need only one or two instruments, it makes economic sense to purchase a couple of rack-and-stack instruments. Third, VXI products tend to best align with those applications that need high performance. Lower performance needs are often met with lower cost solutions such as bench instruments or PCI/PXI plug-in cards.

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VXI and beyond

As the economy picks up, engineers will start purchasing new VXI systems for their high-performance and high-point-count applications. Small, less expensive VXI card cages will make it possible for users with smaller applications to utilize its benefits. As VXI suppliers continue to enhance their products, more users will be attracted. Where the market goes will depend on the product offering. Still, there are other choices as well.

In September 2004, test and measurement companies once again came together to develop the next-generation test system architecture called LAN eXtensions for Instrumentation (LXI). The consortium of 29 members is taking the modular approach of VXI and combining it with PC standards such as Ethernet (IEEE 802.3), TCP/IP protocol, and web browsers. LXI eliminates the card cage, Slot 0, and MXI link that VXI and PXI users complain about. Instead, LXI takes the form of self-contained LXI instruments with keyboards and displays, LXI modules as faceless instruments, or LAN-powered devices. All use a LAN for communications. Figure 3 shows an Agilent LXI standalone 4 x 4 switch matrix.

Figure 3

Modular instrument configurations are now becoming more popular. Instruments and modules are synchronized using the VXI trigger bus, if physically adjacent to each other, or a time synchronous protocol such as IEEE 1588, that can trigger and synchronize devices even if they are miles apart. A VXI module in Slot 0 can be connected to a converter box via GPIB and then bridged to a LAN, enabling modular interoperability with Ethernet-equipped PXI modules as well as LXI instruments. VXI will continue to serve a loyal following, but watch for LXI as it emerges to serve the rest of the market. Ω

Grant Drenkow *is a planner for future test and measurement solutions. He has a BSEE from the University of Nebraska and an MBA from the University of South Dakota. He served six years in the U.S. Air Force as an electronic warfare officer. Grant joined Hewlett-Packard in 1983, where he has worked as a product support engineer, application engineer, regional sales engineer, and product marketing engineer. He also spent four years in Europe as the product line manager for HP VEE and VXI products before his current job.*

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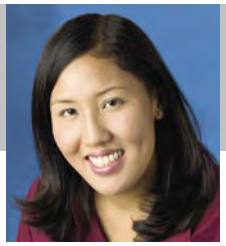
Extend VXI systems via hybrid multi-platform automated test systems



By Faya Peng

The modular test standard VXI continues to win favor with ATE engineers and installations, even while alternatives such as PXI are growing. The reason is VXI's installed base and the status quo nature of long-life legacy systems. Nevertheless, PXI and VXI can happily coexist, bringing the best of breed to hybrid test systems. All that's needed is the judicious use of software architectures that foster interoperability, coupled with open standards such as VISA and IVI.

With the introduction of newer instrumentation platforms, developers are forced to balance longevity needs with the desire to use newer technologies. Because of VXI's success and the existing investment in equipment, VXI sales will continue. At the same time, adoption of PXI has grown rapidly by providing a wide range of instruments at a better price/performance point. To maximize investments in VXI and incorporate PXI and other buses into a system for price and performance reasons, engineers can develop hybrid multi-platform test systems. Hybrid test systems combine multiple instrumentation buses into one system. An example hybrid system is pictured in Figure 1, and various automated test equipment terms are listed in Table 1.

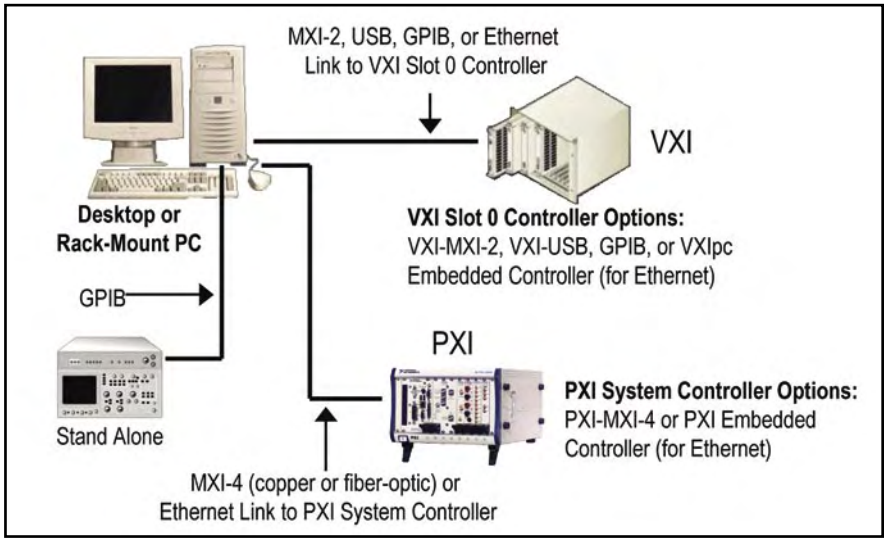


Figure 1

Why VXI sales will continue

The VXI platform has played an important and valued role in automated test. Speculation has arisen, however, as to whether this platform will soon meet its demise and if vendors will continue to design new products and support existing products for this mature platform. Because VXI has been successful and has served the industry well, especially military/aerospace customers, the need for VXI in the marketplace will continue.

VXI sales will continue for a variety of reasons including the extension of existing VXI systems, midlife upgrades, and use of intellectual property tied to VXI. For instance, developers might want to continue to use existing assets like validated instrument models, connectivity designed for VXI, or mechanical enclosures designed for their VXI systems. In addition, customers will continue to use VXI for custom-made VXI boards or specialized VXI instrumentation. As a result, the VXI market will continue and, thus, companies, such as National Instruments, will continue to innovate and support the market.

PXI adoption growing

At the same time, adoption of the PXI platform has grown rapidly and continues to gain momentum and exceed analyst forecasts. The PXI platform pro-

Term	Definition
GPIB	General Purpose Interface Bus
IVI	Interchangeable Virtual Instrument. A software standard for creating a common application programming interface to common test and measurement instruments
MXI	Multiplatform eXtension for Interface. A transparent, high performance interface for bus expansion.
PXI	PCI eXtensions for Instrumentation
VISA	Virtual Instrumentation Software Architecture. A standard for configuring, programming, and troubleshooting instrumentation systems comprising GPIB, VXI, PXI, Serial, Ethernet, and/or USB interfaces.
VXI	VMEbus eXtensions for Instrumentation

Table 1

vides automated test customers with a wide range of instrumentation that offers high performance at a lower price. Part of the growth is due to its applicability to a broad range of applications and adoption in multiple industries including communications, automotive, industrial, consumer electronics, and military/aerospace. This adoption drives investment in new product development, which furthers even more growth.

With this adoption, PXI has been designed into large channel count systems including various military applications. Comparing the number of PXI and VXI system sales further demonstrates this adoption. The research firm Frost & Sullivan reported 5,600 PXI systems in use, as opposed to 2,900 VXI systems in the April 2004 *World VXI and PXI Test and Measurement Equipment Markets* report. With a wide range of high-performance instruments at a lower price, the PXI platform provides an advantageous technology for automated test systems.

Hybrid multi-platform systems are the solution

With existing investments in VXI, developers cannot easily switch to a newer platform like PXI. Rather, hybrid multi-platform test systems enable developers to extend the life of their system, maximize the investment in their existing equipment, and still take advantage of newer technologies. Hybrid test systems combine components from multiple ATE platforms, such as VXI, PXI, GPIB, USB, Ethernet, and others, into one system. By using hybrid systems, engineers can integrate components into their existing system as needed without a complete redesign. The key to creating these hybrid test systems is architecting the system with a layered architecture that helps to streamline the upgrade and maintenance process.

By designing hybrid multi-platform test systems with the five-layer architecture shown in Figure 2, developers can clearly separate hardware from software. This eases legacy replacements and upgrades by requiring only minor changes in specific layers versus redesigning the system to incorporate new components. The architecture starts from the bottom with the device I/O layer, which contains the individual instruments used. Moving up the architecture, the computing layer includes the embedded and remote controllers used to control instruments and interconnect different buses. Above sits

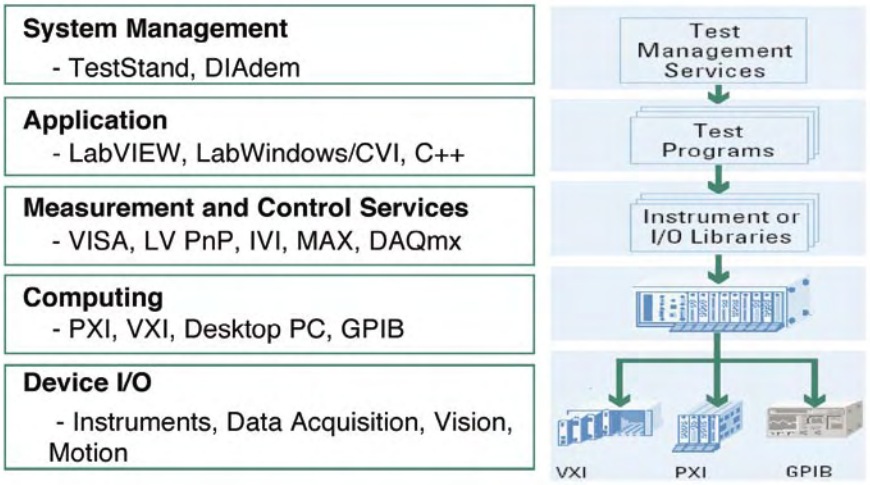


Figure 2

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the measurement and control services layer with the hardware and instrument drivers that bridge the hardware to software. The fourth layer, the application layer, is composed of the individualized test programs such as a digital multimeter measurement or a power spectrum. The architecture ends with the system management layer that provides a framework to call the test programs.

Using the hybrid system architecture enables developers to integrate instruments from different buses into the device I/O layer to create the system that best fits their needs. For instance, engineers can integrate their VXI-related equipment and specialized or custom instruments with the latest technology for high-performance, low-cost instruments. In order to interconnect the various buses in the computing layer, developers have a broad range of controllers from which to choose. Controller considerations, such as the ability to support instrument performance needs and the availability of peripherals for interconnection, affect the ability to expand and scale the system. Figure 3 shows some of the connectivity options available for interconnecting buses. For example, many interfaces are available for remotely controlling a VXI chassis including USB, 1394, and MXI-2. The new NI VXI-USB offers control of VXI through the ubiquitous USB interface with a high sustained throughput of 32 MBps.

Control Interface	Bus Type
Embedded Control	PXI, VXI
PCI-to-PXI	MXI-4
PCI/PXI-to-VXI	MXI-2, USB
VXI-to-PXI	MXI-4[1]
Ethernet-to-PXI	Ethernet
PC to Stand-Alone Instrument	GPIB,USB, Ethernet, Serial

[1]Requires VXIpc with built-in PCI expansion slot

Figure 3

Software is key

While the controllers are very important in providing connectivity to the various instruments, the software framework, composed of the top three layers of the architecture, is key in streamlining legacy replacement, system maintenance, and upgrades. An integral part of the framework is the measurement and control services layer, which includes flexible device drivers that bridge hardware and software and simplify configuration and hardware integration with the test code. To seamlessly integrate hardware into software, engineers need drivers that offer fast performance, programming flexibility, and a consistent and scalable Application Programming Interface (API).

> Hybrid test systems combine components from multiple ATE platforms, such as VXI, PXI, GPIB, USB, Ethernet, and others, into one system.

The open standard Virtual Instrumentation Software Architecture (VISA) provides a common API to communicate with the driver software independent of the instrumentation bus used. By providing controller interchangeability and bus interchangeability, VISA allows developers to interchange controllers used. For example, a system could be converted from VXI to VXI-USB without changing the software. A standard for instrument drivers, Interchangeable Virtual Instrument (IVI) drivers are useful for instrument replacement since they enable engineers to interchange instruments in a system without modifying test software for specified classes of instruments such as oscilloscopes or switches. An IVI instrument driver that conforms to one of these classes may be substituted with another instrument of the same class, regardless of manufacturer or bus connection. More information about IVI is available at www.ivifoundation.org.

In the application layer, developers should build on top of the device drivers and instrument libraries to create reusable, modular test programs. Instead of creating test code that includes tasks at both the system level and unit-under-test level, developers should break out the individual steps of the test program into reusable test modules. The application development environments used should provide ease of use, scalability, and application-level programming flexibility. For instance, NI optimizes test program development by providing instrument driver integration, built-in measurement analysis libraries, and user interface controls in LabVIEW, a graphical development environment, and LabWindows/CVI, an ANSI C-based environment.

The system management layer provides a test framework to build test sequences from the test programs of the application layer. For instance, using NI TestStand, developers can manage the control execution flow of their test code, automate test programs written in any language, manage user interfaces for the various users of the test system, and quicken development time by taking advantage of the reusable test modules. When new instruments are added into a system, the system management layer allows developers to easily add their modular test programs to streamline upgrades and maximize code reuse.

Hybrid multi-platform test systems provide engineers the ability to maximize their investment in VXI equipment and take advantage of newer technologies such as PXI. By using the hybrid five-layer architecture, developers create systems that are scalable and streamlined for maintenance and upgrades. Hybrid systems provide VXI developers a way to extend the lifetime of their systems and introduce newer technologies. Ω

Faya Peng *works as a VXI product marketing engineer for National Instruments where her responsibilities include product management of VXI controllers and chassis. Faya joined NI in September 2002, and served as an applications engineer before going into product marketing. Faya holds a B.S. in electrical engineering from The University of Texas at Austin.*

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Choices: The modular instrument dilemma

By Mark W. Morris

Too much choice is never enough, or is it? In the Automated Test Equipment (ATE) market, choices range from tried-and-true modules such as VXI and GPIB, to lower cost modules such as PXI and PCI, to networked and standalone equipment following USB and network LXI standards. Which is best? The choice depends upon the application requirement. Sometimes a hybrid combination offers the best solution to solving ATE problems.

Today's user has many instrument connectivity options when selecting and developing modern ATE systems. Many in the industry continue to use the traditional rack-and-stack paradigm, using an industry standard GPIB interface to integrate standalone or box-level instruments into the system. As cost, size, and throughput constraints increase, users are now moving to modular system architectures with numerous connectivity options, including VXI, PXI, PCI, USB, and LXI.

Weighing the pros and cons of each option, connectivity options become a source of confusion and even contention. A part of the problem is that comparison data is often skewed as vendors advocate one platform over another. The constant introduction of new technology does not help either. For example, what should a user think about the recently-introduced LAN eXtensions for instrumentation (LXI) platform, or the possibility of modifying the PXI specification to use PCI Express? Will these new choices make a project obsolete even before it begins?

Combining several of these ATE choices into a hybrid system, built using a combination of rack-and-stack and various modular instrument architectures, provides the greatest performance and flexibility benefit to the end user. Before looking at a hybrid system, it's important to examine and compare the different types of modular instrumentation options available to the ATE user.

The need for a modular architecture

There is a tremendous need for modular instrument architectures in the test and measurement industry. Modular instruments provide compact, high-performance hardware and software solutions for automated test and measurement applications. Modular instruments are designed to be integrated and controlled with software running on standard computing systems. Software tools, such as drivers and soft virtual front panels, make system integration possible.

In addition to integration capabilities, modular instrument architectures provide many other benefits. Physical size and bus bandwidth are probably the most obvious benefits over traditional rack-and-stack instrument configurations. By eliminating redundant components, such as displays, power supplies, and control panels, modular instrument systems can reduce the test footprint up to 75 percent. Modular instrument I/O is centrally located and enables mass interconnection to units under test.

Because they utilize high-speed connections to the controlling computer, significant bus bandwidth improvements can also be made when using modular instruments. The migration to high-speed LAN and PCI Express, in some modular implementations, provides a promising future for high bus bandwidth applications. Overall, the modular instrument architecture of choice will ultimately be dependant on the unique needs and requirements of each system.

Modular instrument form factor comparisons

The different modular test standards include VXI, PXI, PCI, LXI, and several others. Each is appropriate in different applications, and it helps to understand the pros and cons before deciding. Increasingly, they can be used together to maximize test and measurement utility.

VXI

VME eXtension for Instrumentation (VXI) has a number of attributes including a data transfer speed up to 80 MBps (160 MBps in newer versions), as well as clearly defined Electromagnetic Compatibility (EMC) and Electromagnetic Interference (EMI) protection. VXI is broadly accepted by ATE users because of its reasonable power consumption, module availability, defined cooling requirements, and software driver standardization (Figure 1).

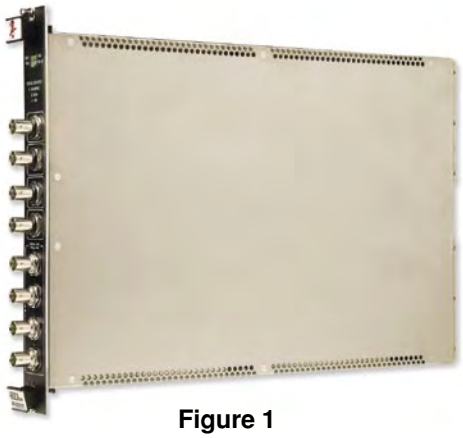

Figure 1

From measuring low-level analog to microwave signals, VXI provides a high-performance modular instrument solution with many available options. Typical VXI chassis (or mainframes) hold 4, 6, or 13 modules. Most VXI systems run Microsoft Windows, UNIX, or VxWorks.

VXI systems can be controlled using embedded or remote controllers. Remote controllers have several advantages, such as the ability to use an industry standard computer and, when using the National Instruments MXI-3 interface, fiber optic cabling up to 200 m without repeaters. Multiple VXI chassis can be daisy chained

using a bus extension module located in each chassis. VXI embedded controllers expand to the right past the slot controller, consuming instrumentation slots in the chassis.

Communications within the VXI system typically uses a mixture of message-based and register-based protocols. Message-based VXI devices use a word-serial protocol, similar to the command strings used to control a GPIB instrument. Message-based devices are very simple to use but communication speed is limited. Register-based devices communicate via the VXI backplane using 16, 24, or 32-bit addressing. Register-based communication provides high-speed data transfers but is often difficult to use. Software drivers that abstract the complexities of register-based devices are highly recommended. Some instruments provide the best of both worlds using message-based commands for basic instrument control and register-based access for high-speed transfers of large blocks of data.

VXI provides several synchronization options. There is a trigger bus on the VXI P2 connector, with eight TTL and two ECL trigger lines; the larger D-size module contains an additional four ECL trigger lines on the P3 connector. The C-size and D-size modules can use a 10 MHz ECL clock from the backplane. Additionally, the D-size module can use a 100 MHz clock. Table 1 provides a comprehensive comparison between a number of modular ATE product types, with metrics ranging from speed, mechanical attributes, and rough order-of-magnitude market sizes.

VXI devices are known for their ruggedness and high performance levels. Because of this, VXI has been aggressively adopted by the demanding users of the military and aerospace industry. Cost is often perceived as a limitation of VXI. As this might be true for some cases, it is important to compare apples to apples when specifying a system. Typically, as channel density increases, the cost of VXI is similar to other modular and rack-and-stack solutions.

PXI

PXI is derived from CompactPCI, but has many additional features. Using two distinct module sizes (3U and 6U), PXI adds timing, cooling, synchronization, environmental standards, EMC, EMI, and standardized software to the industry standard CompactPCI specification (Figure 2).

	VXI	PXI	PCI	USB	LXI	GPIB
Maximum Data Throughput (MBps)						
Theoretical	80	132	132	60	TBD	1
Typical	60	100	100	40	TBD	0.5
EMI/EMC						
Defined Shielding Standard	Yes	No	No	No	TBD	No
Susceptibility to Noise	Low	Medium	High	High	TBD	Low
Cooling						
Defined Cooling Standard	Yes	Yes	No	No	TBD	No
Physical Size						
Height x Depth	Size A	3U (most common)	Standard	No Standard	No Standard	No Standard
	100 mm x 160 mm	100 mm x 160 mm	100 mm x 160 mm			
	Size B	6U	Long			
	233.35 mm x 160 mm	233.35 mm x 160 mm	100 mm x 320 mm			
	Size C (most common)					
	233.35 mm x 340 mm					
	Size D					
	366.7 mm x 340 mm					
Timing and Synchronization						
Synchronization Clock	Yes	Yes	No	Yes	Yes	No
Type	ECL	CMOS	None*	None*	None*	Cable*
* An external source may be used, but there is no set industry standard.						
Power						
Voltages	+5, -5.2, -2, ±12, ±24	+5, +3.3, ±12	±12, +5, +3.3	External or AC	AC Power	AC Power
Communications						
Standardized	Yes	No	No	No	Yes	Yes
Protocols	Message Based	None	None	None	TBD	SCPI
	Register Based					IEEE-488.2
	SCPI					
	IEEE-488.2					
2004 Market Segment Information (Hardware Only)						
Yearly Sales	$250M	$100M	Unknown	Unknown	None	$3B
Consortium Members	19	57	N/A	N/A	30	N/A

Table 1

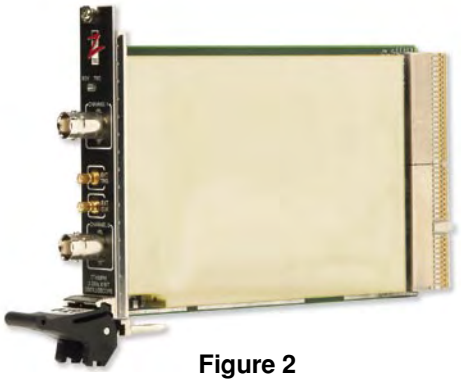

Figure 2

The PXI specification borrowed many of its ideas from VXI. The VXI specification tends to be more rugged and industrial than PXI, especially in areas such as cooling and shielding. However, for most end users and applications, PXI provides most of the same benefits provided by VXI.

The typical PXI chassis contains eight slots for instrument modules, although versions with 4-18 slots are common. An advantage of PXI is that the Slot 0 controller expands to the right and does not consume additional instrumentation slots. Most PXI systems run Microsoft Windows, as described by its specification. Linux is gaining ground, especially by more advanced users.

Like VXI, PXI systems can be controlled using embedded or remote controllers. Most remote controllers use bus bridging technology that provides software transparent slot expansion. Many remote controller options are available, including fiber, and multiple chassis systems are easily supported.

Unlike VXI, PXI modules are limited to register-based communications. Without solid software drivers, it is almost impossible to use a PXI device. Also, since PXI is a superset of PCI, a Microsoft Windows compatible device driver is also required. The good news is that with proper instrument and device driver support, most end users can easily install, configure, and use a PXI device.

Synchronization comes via a 10 MHz timing reference clock and a Star Trigger. Eight backplane trigger lines are also available for use.

Because it is based on the PC architecture, PXI has distinct advantages in the modular instrumentation world. It has a wealth of available software, and is typically less expensive than other modular choices. Some vendors provide software and hardware compatible versions of their products in both PXI and PCI, allowing users to port their system between architectures. Other industries have also adopted PXI and CompactPCI, and provide products for communications, motion control, imaging, and data acquisition. The downside to PXI is the lack of high end and high density instrumentation products.

PCI

The Peripheral Component Interconnect (PCI) standard features a high-bandwidth, serial, interconnect technology that also maintains software compatibility with existing desktop PCI infrastructure (Figure 3). For this reason, PCI is a logical technology for ATE products being developed today.

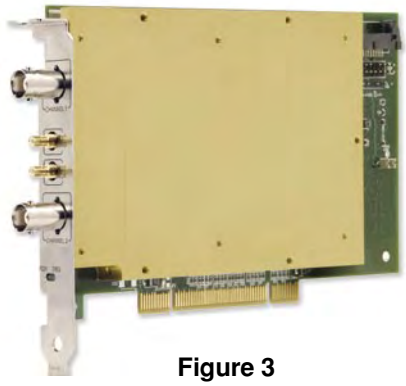

Figure 3

PCI features power supplies similar to those in VXI: ±12 V, 5 V, and 3.3 V. However, power consumption and cooling standards are not well defined as compared with VXI. PCI mainly uses a 100 mm x 160 mm form factor, although the older 100 mm x 320 mm size is also available.

Most desktop PCs contain a few PCI expansion slots. For additional slots, users must look to industrial PC solutions that can contain 4-16 slots and a single board computer. Remote control of PCI chassis is also available. From a software perspective, PCI is identical to PXI. In fact, many manufacturers produce both PCI and PXI versions of their hardware.

The downside to PCI is the lack of standardization in areas such as cooling, environment, power, and synchronization.

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Also, like PXI, there is a lack of high end instrumentation products available in PCI. However, because PCI is a PC industry standard, there are many non-instrument related modules that can be used within the system such as serial ports, LAN interface, storage controllers, and countless others.

PXI and PCI Express

As PCs evolve, so do their bus architectures. With a 2.5 Gbps serial bus, PCI Express is looking to be the next industry standard. In addition to overall improvements in system bandwidth, the PCI Express standard provides dedicated bandwidth to each individual device, called lanes. Each lane has 200 MBps of dedicated bandwidth. Another advantage of PCI Express is that it maintains software compatibility to PCI, making it easier to port old systems to the new architecture. PXI is sure to leverage this new technology and implement a PCI Express compatible version of the PXI specification.

PCI Express will have a significant impact on PCI and PXI systems. As new computing systems eliminate PCI in favor of PCI Express, old PCI hardware will become obsolete. On the contrary, many PXI modules will be "upgradeable" to support new PXI Express products.

USB

Featuring a data bandwidth of 60 MBps, USB is a standard interface already in use on today's desktop and laptop computers and peripherals. Although USB does not define cooling and EMC/EMI standards, it is fully supported by both Windows and Linux operating systems, making it ideal for data acquisition and scientific applications.

Like PXI and PCI, USB devices are highly dependant on software drivers. Although direct access to the USB port is possible, most vendors do not provide direct access to their USB devices.

USB modular instruments are self contained and do not require a chassis or complex controller scheme. Instead, one simply plugs the device into a standard USB port on a laptop or PC. Because of this convenience, plus the standard's ubiquity, USB is an ideal architecture for portable and low-channel count systems. Unlike VXI, PXI, and PCI, USB devices are easily used with laptop computers.

USB is gaining ground for low-cost and low-performance data acquisition applications. USB is also a common connectivity standard to rack-and-stack instrumentation, but higher end modular instrumentation products with USB are not widely available. Also, there is no standard form factor, making it difficult to stack multiple instruments from multiple vendors. Multiple USB instrument triggering and synchronization is not standardized, and USB cabling can also be a burden. Although USB has its place, it does not look to be a standard that will be adopted by large scale ATE.

LXI

LXI is a next-generation test system featuring a compact size and a cost-effective design for LAN-based instrumentation. LXI module sizes are full-rack width and 1U or 2U tall. Rack-and-stack instruments can also be LXI software compliant. The LXI Consortium will maintain the LXI standards that will be developed industry-wide.

LAN-based instrumentation seems to be a logical next step for modular instrumentation connectivity for ATE applications. As the standard develops, more and more products should become available. LXI might eventually replace GPIB as the standard for instrument communication. Ironically, the downside of LXI is also one of its greatest strengths: the use of a local area network. In many corporate environments, with concerns of network health and security, LAN based connectivity might not be as desirable as a dedicated communication method such as USB or GPIB.

GPIB

The General Purpose Interface Bus (GPIB) is an industry standard published by the Institute of Electrical and Electronic Engineers (IEEE) as ANSI/IEEE Standard 488.

Featuring a digital 8-bit parallel communications interface with data transfer rates up to 1 MBps, GPIB supports one system controller, usually a computer, and up to 15 additional instruments. With its 8-bit parallel interface and fast data transfer rates, it is a popular ATE solution.

Additionally, GPIB instruments are easy to program because they respond to common commands and queries in a well defined manner using standard message exchange protocols and data formats. The downside to GPIB is slower data transfer speeds and size. For instance, GPIB's 1 MBps (at 8 bits) is considerably slower than VXI's 80 MBps.

Hybrid systems

It is easy to mix and match rack-mounted, standalone, and modular instrument com-

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ponents into hybrid systems. Due to the availability of established ATE software packages, test and measurement requirements, and perhaps even company budgets, hybrid systems are popular methods to get the best of all modular instrumentation worlds. Components are connected using the many standard bus architectures. This flexibility creates solutions for most applications, such as functional test systems, avionics test benches, telecommunications repair stations, and other ATE. Figure 4 shows an example of a hybrid system using PCI, PXI, and VXI. The different systems are linked to each other via an MXIbus using a bus extension module located in each chassis.

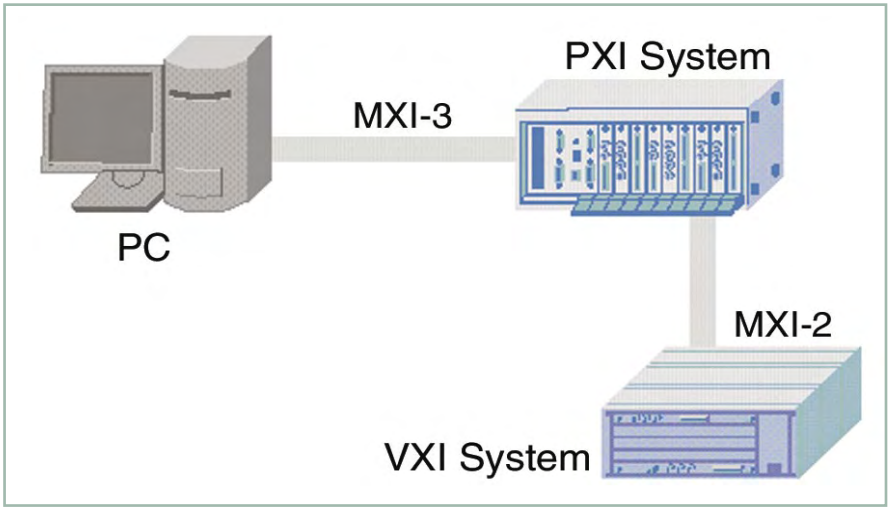

Figure 4

Summing it all up

The dilemma facing today's ATE user is a wealth of choice. Cost, system size, and throughput requirements are just a couple of the questions to answer when deciding between the numerous connectivity options. Each system type provides the ability to solve ATE problems. VXI has traditionally addressed the needs of high-end automated test applications, and it has been very successful in military-aerospace test applications and high-channel-count applications such as manufacturing test. Because of this, VXI will be a viable modular instrument solution for many years to come. On the other hand, VXI will not provide the complete solution in every case.

GPIB instruments, addressing the day-to-day benchtop measurement and testing challenges, will also continue to find their way into ATE. As PXI and PCI provide technology, highly integrated with Windows and Intel processors, they will likely form the backbone of hybrid systems in the future. LXI and USB are the newest members of the list and are just beginning to create their own niche in ATE. Collectively, the availability of VXI, PXI, PCI, USB, LXI, and GPIB simply give the user the power to choose. In the end, application needs and user preferences will be the ultimate determining factor. Ω

Mark Morris, *as vice president of sales and marketing, directs ZTEC Instrument's sales, marketing, and customer support departments and participates in the company's strategic planning process. Before joining ZTEC, Mark held a sales management position with National Instruments, an industry leader in PC-based modular instrumentation. He holds a bachelor's degree in mechanical engineering from the Louisiana State University and an MBA from the University of New Mexico.*

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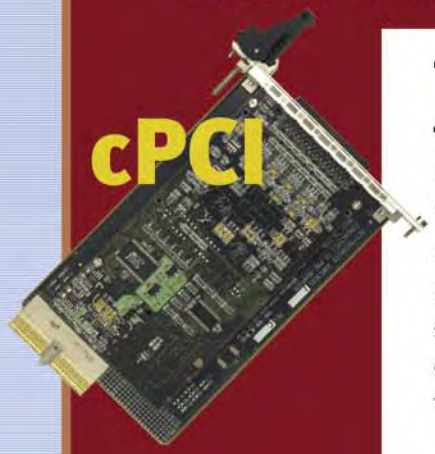

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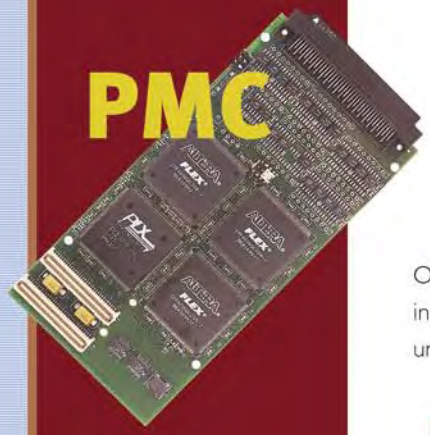
	General Standards	Leading Competitor
Power Dissipation/32 Chan	12 Watts	35 Watts
Phase Skew	55ns (0.1 deg at 5KHz)	Not specified
Crosstalk	96dB	90dB
SINAD	93dB (cPCI, PMC, & PC/104+)	86dB (cPCI), 90dB (PCI)
Gain Accuracy	± 0.1mV, ± 0.1 percent	Not Specified
Sample Rate	200K per Chan (cPCI,PCI,PMC, PC/104+)	108K per Chan (PCI) 216K per Chan (cPCI)
Industrial Temp Range	-40° to 85°C	-40° to 85°C
Commercial Temp Range	0° to 65° C	0° to 50° C
Cost (32 Channels)	$5,995 (Qty 1)*	$9,000

* Cost is for Commercial Temp Version. Quantity discounts available. Conformal coating available.



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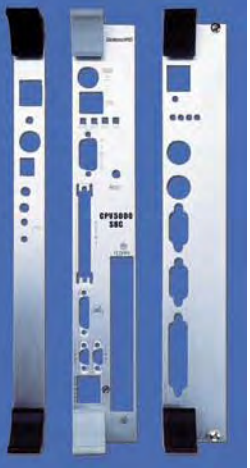

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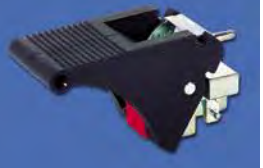

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VME/VXS/VXI Product Directory

Dear Readers,

The challenge for the VME and VXI markets today is to meet upcoming evolutionary needs to accommodate high-performance switch fabrics, high-speed I/O capabilities, state-of-the-art power requirements, entirely new system architectures, and modular interoperability. In the area of test and measurement, VXI continues to meet the needs of large I/O and deployed systems while increasingly becoming a key component in modular interoperable T & M systems. Refer to the Feature articles in the Technology section "VXI still on top."

The VITA 41 VXS "VME Renaissance" standard and its subsequent "dot specs" will bring switched serial fabrics to legacy VME installations with only a simple backplane change – VME32, VME64, and VXS boards can easily coexist. Moreover, multi-gigabit data rates and new I/O and multiprocessor architectures are now available via fabric connections.

The new VITA 46 standard, along with its accompanying VITA 48 Enhanced Ruggedized Design Implementation (ERDI), will bring new levels of I/O routing and system architecture to high-end VME systems. While VITA 46 supports switched serial fabrics, VITA 48 adds support for military two-level maintenance and liquid flow-through cooling. (Refer to articles in this issue in the section "VME I/O Options.")

To cope with these rapid market changes, we've added VXS to our annual Product Directory, as some of the first commercial and COTS products are just now starting to hit the market. *VMEbus Systems* is pleased to offer this directory of products suitable for current and future VME/VXS/VXI projects. Peruse through the following pages, or refer to the table of contents below to find the specific products for your project.

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VME/VXS/VXI Product Directory TABLE OF CONTENTS

Avionics

ARINC 54
MIL-STD-1553 56

Commercial Products

Analyzers 58
COTS 59
Electronic packaging 64
Interface cards 66
Power supplies 68
Test systems 68

Imaging and Targeting Systems

Video 69

Industrial Applications

Data acquisition 70
Electronic packaging 73

Integration, Services & Testing

Integration services 74

Radar/Sonar

Other DSP 75
Radar tracking 76
Sonar data acquisition 77

Rugged Computer Systems

Conduction-cooled 78
Mass storage 79
MIL-STD-1553 81
Mission critical 81
Rugged chassis 83

Single Board Computer

Intel-based 86
PowerPC 88
PowerQUICC 93

Surveillance Systems

Data recording 95

Test and Instrumentation

VXI 94

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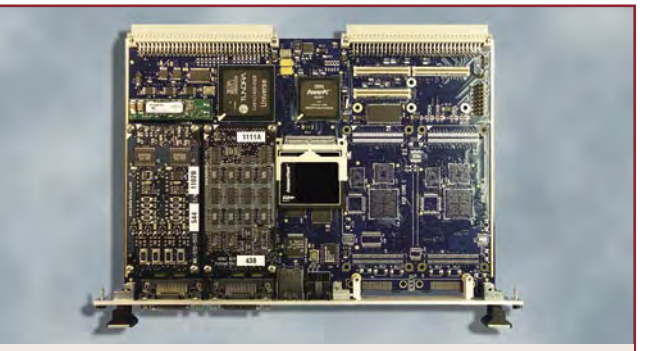

FEATURES:

- Up to 64 ARINC 429 channels
- Parametric versions available
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- PowerPC user processor/CompactFlash socket
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FEATURES:

- COTS convection-cooled 1-½ ATR chassis, tall/long; vertical card mounting (top loading) 6U x 160 mm, VME 64x-compliant
- Power supply: 120 Vac or 28 Vdc; measures 15.38" (W) x 12" (H) x 19.6" (D)
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ACS 6060 is specifically designed for the most demanding applications, which combine very high processing power along with harsh environment conditions. Typical targets include UAVs, helicopters, military transporters, and refuelers.

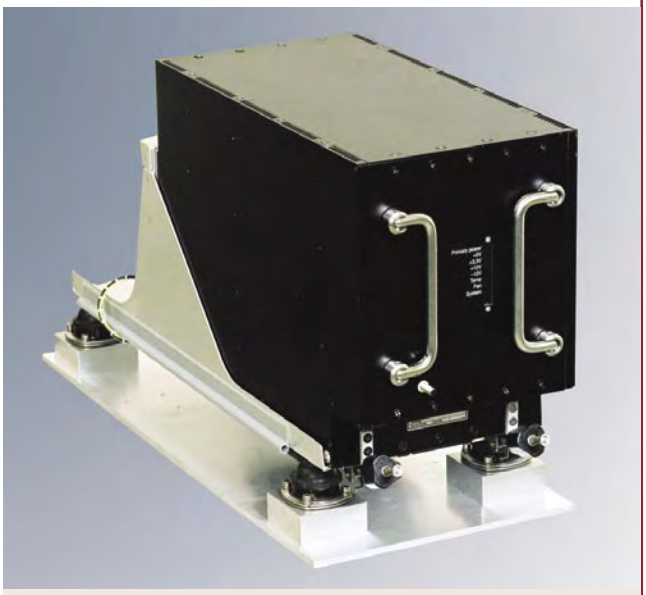
The ACS 6060 is the general-purpose chassis for mission computers requiring conduction-cooled technology. It features multiple innovations in three areas (versatility, environment, and maintainability) and combines the three most important COTS standards (PCI, VME64x, and ARINC 600).

The small form factor, five-slot ARINC 600, fits CES conduction-cooled VME or PMC boards to create virtually any mission computer version. The construction allows instant access to the complete payload with a less than five-minute exchange to all boards.

The ACS 6060 chassis has been designed to be part of the CES generic mission computer product line and, in this context, houses two COTS connectors on the backplane (PCI and VME) for parallel processing.

Other related CES conduction-cooled models include:

- RIO3 8066/RIO4 8076 – VME processor boards
- PEB 6426 – PMC extension board
- MFCC 8446 – Multifunction computing core PPMC
- GPIO 8406 – User-programmable I/O PMC
- MIL-5364 – MFCC-based MIL-STD 1553B PMC
- ARINC 8429 – ARINC 429 PMC
- CAN 8428 – CANbus PMC



FEATURES:

- Conduction-cooled ARINC 600 high-power chassis
- Five slots for 6U boards
- PCI/VME64x backplanes
- Hosts combinations of CES modular computing elements, including processors, avionic interfaces, and network interfaces
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Software

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FEATURES:

- One, two, or four dual-redundant MIL-STD-1553 A/B Notice II channels
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- High-level API for Windows XP, 2000, Me, NT, 98, 95, Red Hat Linux, and VxWorks included
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The FC-75000 FibreACCESS series cards are dual redundant Fibre Channel controller PMCs optimized for use in military/aerospace applications. The FibreACCESS controller can operate at either 1 Gbps or 2 Gbps data rates in point-to-point, arbitrated loop or switched fabric topologies. FibreACCESS cards are available with either electrical or optical interfaces on a conduction-cooled PMC form factor.

Based on DDC's own Fibre Channel technology, FibreACCESS's architecture is optimized to meet the highly deterministic performance, high reliability, and demanding environmental requirements of embedded, real-time military applications. Its flexible, FPGA-based architecture can be tailored to meet a wide range of specific system requirements. Moreover, FibreACCESS is not subject to rapidly changing commercial market forces that can result in shortened life cycles. Instead, DDC's FibreACCESS technology has been designed to meet the multi-decade life cycle demands of military/aerospace programs, continuing DDC's demonstrated commitment as a long-term military COTS supplier of digital interface devices.

FibreACCESS supports Class 2 acknowledged and Class 3 unacknowledged Fibre Channel service. The cards provide leading-edge performance, which includes the capability to sustain data rates of more than 300 MBps when operating at a 2 Gbps data rate. The card's built-in DMA engines and 64-bit/66 MHz PCI initiator/target interface, which operates in conjunction with the FibreACCESS Frame/Sequence/Exchange management controller, autonomously move payload data to and from PCI space. Using host initiated descriptors, frames are assembled and disassembled autonomously to and from payload buffers in host memory.

Applications

DDC's FibreACCESS controller is suitable for a wide variety of applications for embedded avionics and vetronics systems. These include sensor interfacing, multiprocessor and DSP arrays, radar systems, display systems, and storage.

FEATURES:

- DDC-developed technology to support long life cycles
- Redundancy: Dual independent ports and autonomous failover
- Conduction-cooled PCI Mezzanine Card (PMC) providing extended temperature operation
- 1 Gbps or 2 Gbps operation
- Support for Class 2 and 3 service, including broadcast and multicast
- 320 MBps throughput with memory-to-memory latency under 100 *uS*
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- ASM, FC-AE-1553, TCP/IP, and UDP/IP support

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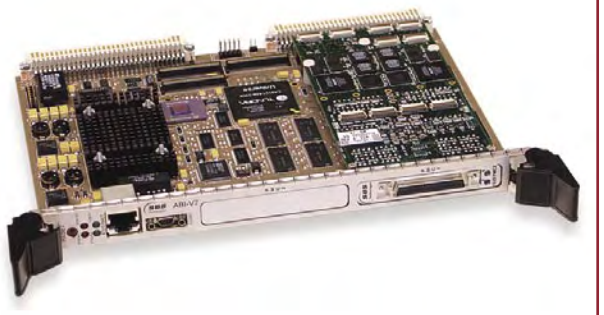
The ABI-V7 from SBS Technologies provides one or two dual redundant MIL-STD-1553 channels for VME.

The ABI-V7 supports the requirements of most VME applications for integration, test, simulation, and test equipment applications.

The ABI-V7 provides a flexible, full function, two-channel, dual redundant MIL-STD-1553 interface to the VMEbus system, including concurrent and independent operation of a Bus Controller (BC), 31 Remote Terminals (RT), and dual function Bus Monitor (BM).

Featuring an onboard PowerPC processor, the ABI-V7 includes error injection, DMA, and extensive triggering options.



FEATURES:

- Cuncurrent operation as Bus Controller with 31 Remote Terminals and a dual-function Bus Monitor
- Latest design 1553 VME test and simulation interface
- One or two dual redundant MIL-STD-1553 channels
- Eight triggers and selectable coupling
- Optional 48-bit IRIG-B clock input
- Supports DMA

For more information, contact: info@sbs.com

RSC #5801 @www.vmebus-systems.com/catalogrsc

VMETRO, Inc.

1880 Dairy Ashford, Suite 400
Houston, TX 77077
Tel: 281-584-0728 • Fax: 281-584-9034

VG-VME Analyzer

www.vmetro.com

The Vanguard VMEbus Analyzers debug, test, and validate next-generation boards and systems. This VME-based system captures and displays bus activity up to 133 MHz with powerful trigger and store qualifiers. Extensive statistics functions are included to measure system performance. The exerciser can act as a master or target enabling the Vanguard to generate bus traffic and emulate devices not yet available. The protocol checker automatically detects 60 VME protocol errors. All functions operate independently and concurrently.

The Vanguard is controlled via USB or Ethernet from a PC running Windows and VMETRO's BusView GUI.

FEATURES:

- Ethernet or USB communications
- Supports VME, VME64, 2eVME, and 2eSST
- 2 MS trace buffer at 256 bits
- State and timing analyzer
- Advanced exerciser with master, slave, system controller, interrupt generator, and handler
- Automatic Protocol Checker

For more information, contact: info@vmetro.com

RSC #5802 @www.vmebus-systems.com/catalogrsc

Annapolis Micro Systems, Inc.
190 Admiral Cochrane Drive, Suite 130
Annapolis, MD 21401
Tel: 410-841-2514 • Fax: 410-841-2518

WILDSTAR II Pro PCI

www.annapmicro.com

Annapolis Micro Systems is a world leader in high-performance COTS FPGA-based processing for radar, sonar, SIGINT, ELINT, digital signal processing, FFTs, communications, software radio, encryption, image processing, prototyping, text processing, and other processing intensive applications. Our ninth-generation WILDSTAR II Pro for PCI uses Xilinx's newest Virtex II Pro FPGAs for state-of-the-art performance. It accepts one I/O card in one, or up to two I/O cards in two PCI or PCI-X slots, including dual 1.5 GHz A/D, single 1.5 GHz A/D, Quad Fibre Channel 2, Quad 105 MHz, Quad Gigabit Ethernet, WILDSTAR Data Port (WSDP), FPDP, and LVDS.

Our boards are on a large number of operating systems, including Win (NT, 2000, XP), Linux, DECAlpha, Solaris, IRIX, ALTIX, MacOS, and VxWorks. We support our board products with a standardized set of drivers, APIs, and VHDL simulation models. We offer training, including customized application development and customer support. Develop your application very quickly with our CoreFire™ FPGA Application Builder, which transforms the FPGA development process, making it possible for theoreticians to easily build and test their algorithms on the real hardware that will be used in the field. CoreFire is based on data flow and automatically generates distributed control fabric between cores. Our extensive IP and board support libraries contain more than 800 cores, including floating point and the world's fastest FFT. CoreFire uses a graphical user interface for design entry, supports hardware-in-the-loop debugging, and provides proven, reusable, high-performance IP modules. WILDSTAR II Pro for PCI, with its associated I/O cards,provides extremely high overall throughput and processing performance. The combination of our COTS hardware and CoreFire allows our customers to make massive improvements in processing speed, while achieving significant savings in size, weight, power, person-hours, dollars, and calendar time-to-deployment.

FEATURES:

- One to two Virtex II Pro Xilinx FPGA processing elements – XC2VP70 or XC2VP100
- Up to 96 MB DDRII or QDRII SRAM
- Up to 256 MB DDR DRAM
- Programmable Flash for each processing element to share FPGA images
- Works with PCI or PCI-X backplane
- High-speed DMA multichannel PCI controller
- Host software: Win NT, 2000, XP, Linux, Solaris, MacOS, DECAlpha, IRIX, and ALTIX
- Full CoreFire board support package for fast, easy application development
- VHDL model, including source code for hardware interfaces
- Save time and effort and reduce risk with COTS boards and software
- Achieve world-class performance – WILD solutions outperform the competition
- Includes one-year hardware warranty, software updates, and customer support; training available

For more information, contact: wfinfo@annapmicro.com

RSC #59 @www.vmebus-systems.com/catalogrsc

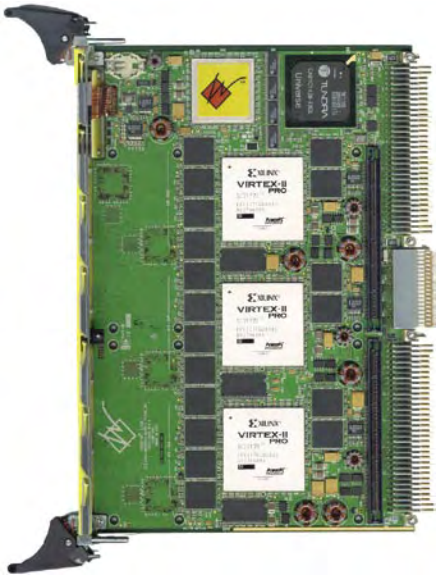
Annapolis Micro Systems, Inc.
190 Admiral Cochrane Drive, Suite 130
Annapolis, MD 21401
Tel: 410-841-2514 • Fax: 410-841-2518

WILDSTAR II Pro VME

www.annapmicro.com

Annapolis Micro Systems is a world leader in high-performance COTS FPGA-based processing for radar, sonar, SIGINT, ELINT, digital signal processing, FFTs, communications, software radio, encryption, image processing, prototyping, text processing, and other processing intensive applications. Our ninth-generation WILDSTAR II Pro for VME uses Xilinx's newest Virtex II Pro FPGAs for state-of-the-art performance. It accepts up to two I/O cards in one VME64x slot, including dual 1.5 GHz A/D, single 1.5 GHz A/D, Quad Fibre Channel 2, Quad 105 MHz, Quad Gigabit Ethernet, WILDSTAR Data Port (WSDP), FPDP, and LVDS. We host our boards on a large number of operating systems, including Win (NT, 2000, XP), Linux, DEC Alpha, Solaris, IRIX, ALTIX, MacOS, and VxWorks.

We support our board products with a standardized set of drivers, APIs, and VHDL simulation models. We offer training, including customized application development and customer support. Develop your application very easily with our CoreFire™ FPGA Application Builder, which transforms the FPGA development process, making it possible for theoreticians to easily and quickly build and test their algorithms on the real hardware that will be used in the field. CoreFire is based on data flow and automatically generates distributed control fabric between cores. Our extensive IP and board support libraries contain more than 800 cores, including floating point and the world's fastest FFT. CoreFire uses a graphical user interface for design entry, supports hardware-in-the-loop debugging, and provides proven, reusable, high-performance IP modules. WILDSTAR II Pro for VME, with its associated I/O cards, provides extremely high overall throughput and processing performance. The combination of our COTS hardware and CoreFire allows our customers to make massive improvements in processing speed, while achieving significant savings in size, weight, power, person-hours, dollars, and calendar time-to-deployment.



FEATURES:

- One to three Virtex II Pro Xilinx FPGA processing elements – XC2VP70 or XC2VP100
- Up to 144 MB DDRII or QDRII SRAM
- Up to 384 MB DDR DRAM
- Programmable Flash for each processing element to store FPGA images
- Works with VME64x backplane
- High-speed DMA multichannel PCI controller
- Host software: Win NT, 2000, XP, Linux, VxWorks, Solaris, MacOS, DECAlpha, and SGI
- Full CoreFire board support package for fast, easy application development
- VHDL model, including source code for hardware interfaces
- Save time and effort and reduce risk with COTS boards and software
- Achieve world-class performance – WILD solutions outperform the competition
- Includes one-year hardware warranty, software updates, and customer support; training available

For more information, contact: wfinfo@annapmicro.com

RSC #60 @www.vmebus-systems.com/catalogrsc

Annapolis Micro Systems, Inc.
190 Admiral Cochrane Drive, Suite 130
Annapolis, MD 21401
Tel: 410-841-2514 • Fax: 410-841-2518

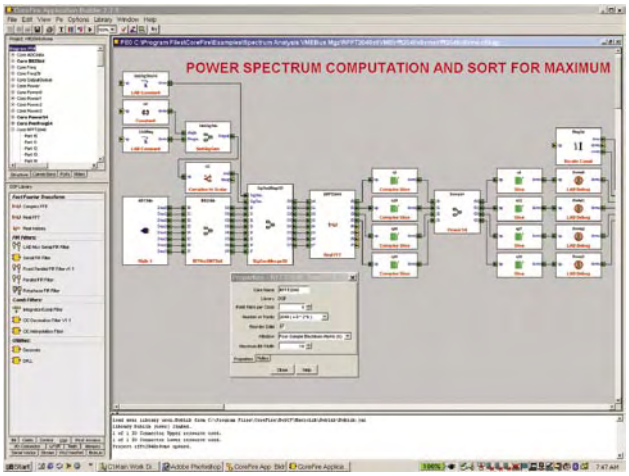
CoreFire FPGA Design Suite

www.annapmicro.com

Develop your application very quickly and easily with our CoreFire™ FPGA Application Builder, which transforms the FPGA development process, making it possible for theoreticians to easily and quickly build and test their algorithms on the real hardware that will be used in the field. Use CoreFire's graphical interface to drag and drop library elements onto the design window. Modify your input and output types, numbers of bits, and other core variables by changing module parameters with pull-down menus. The modules automatically provide correct timing and clock control. Insert debug modules to report actual hardware values for hardware-in-the-loop debugging. Hit the Build button to check for errors and as-built core sizes and to build an encrypted EDIF file. Use the Xilinx ISE tool to place and route each FPGA design. Modify and use the jar file or the C program created by the CoreFire Build to load your new file into your WILDSTAR II and I/O card hardware. Use the CoreFire Debugger to view and modify register and memory contents in the FPGA, and to step through the data flow of your design running in the real physical hardware.

Our extensive IP and board support libraries contain more than 800 proven, reusable high-performance cores, including FIR and CIC filters, a channelizer, and the world's fastest FFT. We support conversion between data types: bit, signed and unsigned integers, single precision floating point, integer and floating point complex, and arrays. A few of the newly added array cores include array composition and decomposition; slice, parallelize, serialize, repack, split, merge, reorder, rotate, and concatenate transformations; matrix math, sliding windows, and convolutions.

The combination of our COTS hardware and CoreFire enables our customers to make massive improvements in processing speed while achieving significant savings in size, weight, power, person-hours, dollars, and calendar time-to-deployment.



FEATURES:

- Data-flow-based – automatically generates intermodule control fabric
- Drag and drop graphical interface
- Work at high conceptual level – concentrate on solving algorithmic problems
- Hardware-in-the-loop debugging
- More than 800 modules incorporate years of application experience
- Reduce risk
- Save time to market
- Save development dollars
- Easily port completed applications to new technology chips and boards
- Training and custom application development available
- Achieve world-class performance – WILD solutions outperform the competition
- Annual node locked or networked license; includes customer support and updates

For more information, contact: wfinfo@annapmicro.com

RSC #61 @www.vmebus-systems.com/catalogrsc

Pentek, Inc.
One Park Way
Upper Saddle River, NJ 07458-2311
Tel: 201-818-5900 • Fax: 201-818-5904

Pentek Model 6822

www.pentek.com

Model 6822 is a dual-channel 6U VMEbus board for high-speed data acquisition and signal processing. With sampling rates to 215 MHz, it features two of the fastest 12-bit A/D converters on the market and supports fast data rates with several high-speed interface options. Up to four FPDP II connectors deliver output data with rates to 320 MBps each. A VXS interface provides two 1.25 GBps switched serial fabric ports to the VME backplane.

Targeting very high-performance DSP tasks, the Model 6822 couples its high-speed A/Ds to two Xilinx Virtex-II Pro FPGAs, each supported by 16 MB of FLASH and 128 MB of SDRAM. Each 128 MB SDRAM can be used as a circular buffer, digital delay, or as real-time transient capture memory.

The XC2VP50 FPGAs enable users to perform critical real-time, high-frequency signal processing tasks such as demodulation, convolution, filtering, and data analysis. This capability can reduce the data rate of off-board traffic in many applications. Other applications can take advantage of high-speed I/O connections that support the board's highest data rates.

The VXS port on the P0 backplane connector makes the Model 6822 one of the first boards in the industry to offer VXS. The port follows the VITA 41 specification for VME backplane switched serial fabrics and supports several protocols through installation of one of the various fabric IP cores now available. The initial release of the Model 6822 supports Serial RapidIO and the Xilinx Aurora protocols over the VXS port.

As an alternative to the front-panel data connectors, an optional 24-pair LVDS data channel through the P2 backplane connector is also available. In addition, a front panel sync/timing bus facilitates synchronous, triggered data acquisition across multiple boards. This capability is essential for multichannel applications such as radar beamforming and direction finding.

For more information, visit: www.pentek.com/go/vme6822

FEATURES:

- COTS board digitizes and processes up to 700 MHz I/F signals
- A/D sampling rates to 215 MHz
- High-speed I/O options include VXS, multiple FPDP II ports, and LVDS
- Supports onboard Xilinx Virtex-II Pro FPGAs with Pentek GateFlow® FPGA resources: Design Kit, IP cores, installed cores
- Pentek ReadyFlow® Board Support Libraries for quick startup and operation
- Available in commercial (L0), air-cooled (L1, L2), and conduction-cooled (L3, L4) versions
- Aimed at environments such as unmanned military reconnaissance vehicles, airborne radars, and maritime communications systems
- Designed for radar, signal intelligence, high-frequency data acquisition, and signal processing systems
- First product in a family of boards designed from the ground up to cover the full range of environmental specs

Technobox, Inc.
PMB 300, 4201 Church Road
Mount Laurel, NJ 08054
Tel: 609-267-8988 • Fax: 609-261-1011

4383 http://www.technobox.com

This PCI-X capable board provides four 1.5 Gbps links to support as many as four cable-attached SATA devices. Although designed for PCI-X, the 4383 will also function with lower speed 33/66 MHz buses and in 32/64-bit modes. It supports 3.3 V and 5 V bus signaling. Four SATA ports are front-panel accessible. Each port has a retention mechanism. Status LEDs show link activity. BIOS is stored in EEPROM, accessible via a Serial Peripheral Interface (SPI) bus.

FEATURES:

- Supports four SATA devices (1.5 Gbps per link)
- Intel 31244 controller
- PCI-X capable (33/66 MHz, 32/64-bit modes; 3.3 V and 5 V bus signaling)
- Status LEDs show link activity
- Onboard BIOS (EEPROM)

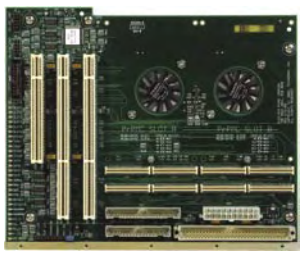
For more information, contact: info@technobox.com **RSC #6301 @www.vmebus-systems.com/catalogrsc**

COTS | VME/VXS/VXI product directory | 2005

Technobox, Inc.
PMB 300, 4201 Church Road
Mount Laurel, NJ 08054
Tel: 609-267-8988 • Fax: 609-261-1011

3923 http://www.technobox.com

The 3923 is a FlexATX Processor PMC (PrPMC) carrier and development platform. This carrier board provides two PMC sites plus three PCI card slots (two 64-bit and one 32-bit). Using the 3923, a designer can work with a single PrPMC, dual PrPMCs, or a PrPMC and PMC for hardware and/or software development. All PCI slots are keyed for 3.3 V signaling. The PCI bus will run at 66 MHz, if all PCI cards assert 66 MHz enabled. At least one PMC site must be populated with a PrPMC running in Monarch mode. Site A's rear I/O is directed to connectors for a floppy disk and/or external IDE device. Each site has a fan to cool the mounted PrPMC or PMC.



FEATURES:

- FlexATX platform for PrPMC development and/or delivery
- Dual PMC sites allow various configurations with PrPMCs and PMCs
- Slots for three PCI cards (two 64-bit, one 32-bit); rear I/O access for external IDE or floppy drive
- Auxiliary cooling for PMC sites
- LED status for memory, configuration, I/O access, power, PCI interrupt, and bus mastering activity
- Site B rear I/O is directed to a DIN connector that emulates P2 of a VMEbus board

For more information, contact: info@technobox.com **RSC #6302 @www.vmebus-systems.com/catalogrsc**

SBS Technologies

7401 Snaproll NE
Albuquerque, NM 87109
Tel: 505-875-0600 • Fax: 505-875-0400

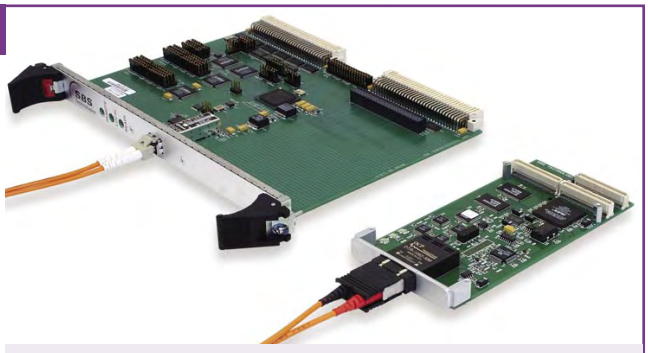
Adapters VME-to-Xx

www.sbs.com

The 800 Series of bus adapters from SBS Technolgies enables users to connect VME systems together with other VME chassis, desktop PCs, CompactPCI chassis, or any system with a PMC site.

Featuring fiber-optic connectivity that provides up to 70 MBps DMA transfers and supports node-to-node distances up to 500 M, the SBS 800 Series enables the seamless integration of VME systems with a variety of other types of systems.

Applications include controlling VME racks from a desktop PC, connecting multiple VME racks to create a powerful, virtual system, and connecting VME and CompactPCI systems together.



FEATURES:

- Connects VME to VME64, PCI, PMC, or CompactPCI
- Up to 70 MBps controller mode DMAs
- Fiber-optic connection to 500 M
- Support for two programmed interrupts
- Up to 8 MB of optional dual-port RAM

For more information, contact: info@sbs.com

RSC #6401 @www.vmebus-systems.com/catalogrsc

Elma Bustronic

4350 Grimmer Blvd.
Fremont, CA 94538
Tel: 510-490-7388 • Fax: 510-490-1853

VME Backplanes

www.bustronic.com

Elma Bustronic is the industry leader in standard and customized VME-based backplanes. Models include versions in VME, VME64x, VXI, and VXS architectures.

Elma Bustronic has the widest range of VME-based backplanes in the industry. The company is renowned for its experienced design team that provides customized VME backplanes with the utmost quality, expertise, and completion time. Elma Bustronic uses simulation/characterization tools to optimize their designs.

FEATURES:

- VME – 3U and 6U heights; J1 + J2 monolithic, J1 only, J2 only, J0 only, and power and ground types; 2-21 slots
- VME64x – 6U and 7U heights; 7U versions meet VITA 1.7 High Current specification; 2-21 slots
- VXS – 6U and 7U heights; Star, Dual Star, and Switchless Mesh topologies; 5 (two versions), 8, 12, and 20-slot sizes
- VXI – 6U (C) and 9U (D) heights; 5-13 slot sizes
- Optimized via signal integrity studies

For more information, contact: info@bustronic.com

RSC #6402 @www.vmebus-systems.com/catalogrsc

Electronic Solutions
14100 Danielson Street
Poway, CA 92064-6898
Tel: 888-957-8291 • Fax: 858-679-4555

Electronic Solutions
a business unit of apw Ltd.

2U System Chassis

www.electronicsolutions.com

Designed for 19" rack-mount or desktop use, Electronic Solutions' 2U CompactPCI system chassis are suitable for housing VME64x System Chassis in either a production system or development environment with low board count and limited space. Enough airflow is produced to dissipate the large amounts of heat generated by the latest generation of computer boards. Rear transition module support enables pass-through I/O to the rear of the chassis to free up the front board for insertion and extraction, especially useful for development systems.

Various power options include AC and DC, embedded and pluggable, as well as power levels to match your application.

FEATURES:

- 2U Zephyr chassis:
  – 3.47" (H) x 17.0" (19" rack mount) (W) x 11.75" (D)
- High-performance VME64x backplane:
  – With or without P0 connector
- Optimized fan cooling:
  – 39 CFM total chassis airflow
  – 354 LFM average
- Card frame meets IEEE 1101.10 & 11
  – Four-slot rear transition module support
- Power supply options:
  – Up to two front pluggable 200 W power supplies (1+1 redundant)
  – Or an embedded 1U 250 W ATX power supply
- Possible future backplane options include:
  – VITA 31.1 and VITA 41 backplane
- Provision for accessory mounting of 5.25" and 3.5" slim peripherals (in place of a pluggable power supply position)
- Hot-swappable, front-loading fan tray for ease of servicing
- Provision for mounting embedded 2.5" hard drive

For more information, contact: sales.elsol@apw.com

RSC #65 @www.vmebus-systems.com/catalogrsc

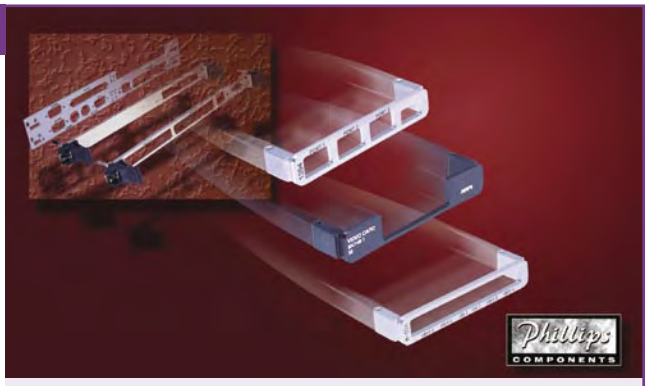
Phillips Components, Inc.

23142 Alcalde Drive, Suite A
Laguna Hills, CA 92653
Tel: 800-899-4263 • Fax: 949-583-9337

VME, CPCI Panels www.phillipscomponents.net

Phillips Components has been in business since 1976 and is a leader in the fabrication of VME, PMC, PCI, and CompactPCI panels, as well as a large line of ejectors, extractors, pullers, and card guides.

We are a one-stop shop. We customize, grain, plate, silkscreen, and assemble the entire panel for you. We have great lead times and customer service!



FEATURES:

- VME panels and hardware
- CompactPCI panels and hardware
- PMC bezels
- PCI brackets
- Ejectors – card guides
- Custom molding

For more information, contact: info@phillipscomponents.net **RSC #6601 @www.vmebus-systems.com/catalogrsc**

Technobox, Inc.

PMB 300, 4201 Church Road
Mount Laurel, NJ 08054
Tel: 609-267-8988 • Fax: 609-261-1011

4170 http://www.technobox.com

This PMC board, which is built around the Silicon Image 680, is designed to accept 2.5" ATA/IDE mass storage media, as either a rotating hard disk drive or solid state Flash disk, using industry standard mounting.

Media is normally installed by the end user.

FEATURES:

- Silicon Image 680 controller
- Accepts 2.5" ATA/IDE HD or solid-state disk
- Standard mounting
- Link activity LED
- Media optional

For more information, contact: info@technobox.com **RSC #6602 @www.vmebus-systems.com/catalogrsc**

Technobox, Inc.
PMB 300, 4201 Church Road
Mount Laurel, NJ 08054
Tel: 609-267-8988 • Fax: 609-261-1011

4289 http://www.technobox.com

The enhanced 32-channel reconfigurable RS-422/485 digital I/O PMC provides a vehicle for implementing complex digital designs requiring a differential interface. A second-generation, FPGA-based design, the 4289 includes 64 b/66 MHz PCI bus support, up to 66 MHz local bus clock, 256 k x 32 b SRAM, and up to 20 k logic elements. Standard configuration is 12 k LEs. Other sizes are build options. All 32 general-purpose RS-422/485 digital I/Os are wired to both front panel and rear connectors. FPGA configuration cells are automatically loaded from a serial EPROM during power-up.

FEATURES:

- Provides 32 channels of general-purpose RS-232/422 digital I/O
- 12 k LEs (standard configuration)
- Reprogrammable by host or onboard Flash (EP1CS4)
- Variable SRAM architectures allowed
- Headers for JTAG connection and Flash programming
- Sample FPGA implementation and host "C" code

For more information, contact: info@technobox.com **RSC #6701 @www.vmebus-systems.com/catalogrsc**

Interface cards | VME/VXS/VXI product directory | 2005

Technobox, Inc.
PMB 300, 4201 Church Road
Mount Laurel, NJ 08054
Tel: 609-267-8988 • Fax: 609-261-1011

4044 http://www.technobox.com

The 4044 passive adapter permits standard 32 or 64-bit PCI-X card operation in a PMC-X slot. One PCI-X edge finger connector supports keying for 32-bit 5 V signaling PCI cards. A second supports 32 or 64-bit 3.3 V signaling PCI-X cards. A universal PCI-X card can be used in either position. Six 20-pin connectors (HP 01650-63203 termination) provide an interface for a logic analyzer. Onboard logic decodes PCI-X bus cycles, with associated LEDs indicating status. Additional LEDs monitor power supplies and key signals. Test points allow supply voltage measurements. Pulse stretchers allow visible detection of short-lived events.

FEATURES:

- Adapts 32 or 64-bit PCI cards to a PMC site
- Supports 33/66 PCI-X clock frequencies
- Logic analyzer headers (compatible with HP 1650-63203 termination adapters)
- LEDs convey PCI bus operation (PCI bus command code decoded for individual LEDs)
- Supports bandwidth measurement; LEDs display power, bus signals, and bus cycles

For more information, contact: info@technobox.com **RSC #6702 @www.vmebus-systems.com/catalogrsc**

Tracewell Systems Inc.
567 Enterprise Drive
Westerville, OH 43081
Tel: 800-848-4525 • Fax: 614-846-4450

Tracewell Systems

TTX400 3U/6U 24Vdc

http://tracewellsystems.com/products/Powersupplies.htm

Tracewell's TTX power supplies are ideal for applications requiring dependable performance under harsh conditions. The TTX provides high-density (400 W in just 3U), high-efficiency reliability and control, all within one slot. The planar magnetic design is software controlled, allowing greater than 80 percent efficiency and full power operation up to 60 °C. MOSFETs replace OR-ing diodes to reduce heat dissipation.

Magnetics and MOSFETs have direct thermal contact with the side-mounted heat sink for exceptional heat transfer and low airflow restriction, further improving reliability in harsh conditions. TTX can also be adapted for odd form-factor applications.

FEATURES:

- Wide input range from 18-36 Vdc for 24 or 28 Vdc applications
- High current DC outputs include 5 V/30 A, 3.3 V/45 A, +12 V/5 A, -12 V/1 A; custom output options available
- Available in 3U versions up to 350 W and 6U versions up to 700 W; optional two-slot design for low airflow applications
- Active monitoring for voltage, temperature, and output current with optional I2C control per IPMI v1.5
- Hot-swap compliant, single-wire active current share for up to eight supplies
- Adaptable for special form factors, including non-air-cooled requirements; conformal coat is also available

For more information, contact: sales@tracewell.com

RSC #6801 @www.vmebus-systems.com/catalogrsc

Tracewell Systems Inc.
567 Enterprise Drive
Westerville, OH 43081
Tel: 800-848-4525 • Fax: 614-846-4450

Tracewell Systems

T-Frame for VXS

http://tracewellsystems.com/products/vxs.htm

Tracewell's T-Frame development platform is now available for high-speed serial VITA 41, VXS applications. This versatile system is a must for any hardware or software development. The hybrid, eight-slot backplane includes four VXS payload slots, two VXS switch slots, and two conventional VME64x slots for added versatility.

The patented open design enables easy access to boards without using extender cards. Enhanced cooling supports boards up to 100 W. Power supplies provide 350 W or 700 W and can be plugged into either front or rear slots for improved access. Advanced monitoring displays output voltages, currents, and exhaust temperature.

FEATURES:

- Hybrid backplane supports both VME64x and VXS boards and is optimized for up to 3.125+ Gbps per link
- Dual-star design supports one or two switch boards, allowing test of both link ports on the payload cards
- High pressure cooling supports up to 100 W per slot and provides separate cooling for boards and power supplies
- Patented open-frame design eliminates the need for extender boards
- Voltage, current, and temperature monitoring with margin control for +5 and +3.3 V outputs
- Plug-in power supplies support 350 W, N+1, or 700 W operation

For more information, contact: sales@tracewell.com

RSC #6802 @www.vmebus-systems.com/catalogrsc

Hybricon Corporation

12 Willow Road
Ayer, MA 01432
Tel: 1-877-HYBRICON • Fax: 978-772-2963

Airborne Video Processor

www.hybricon.com

This system designed by Hybricon Corporation enables the use of multiple video processing cards in a high-altitude airborne environment. An intelligent temperature control system maintains internal temperatures above 0 °C with minimal impact on the power budget. The system was designed with both LED monitoring and optional remote monitoring. EMI/RFI (MIL-STD-461-D) control is provided by honeycomb filtering on all inlets and outlets and proper design of gasketing at all metal seams. Front to rear side cable passages, a recessed card cage, and removable front cover provide complete cable management with tight EMI/RFI containment.

FEATURES:

- FAA certified to airborne shock, vibration, and environmental requirements
- Redundant power supplies increase system reliability
- Integration of CPU/carrier cards with multiple video and fiberoptic PMC and IP modules
- Complete cabling of copper and fiber interfacing
- Internal heater and control system enables operation of integrated COTS content below rated minimum operating temperatures
- Intelligent temperature control and fan speed control with remote monitoring options

For more information, contact: info@hybricon.com

RSC #6901 @www.vmebus-systems.com/catalogrsc

Video | VME/VXS/VXI product directory | 2005

Radstone Embedded Computing

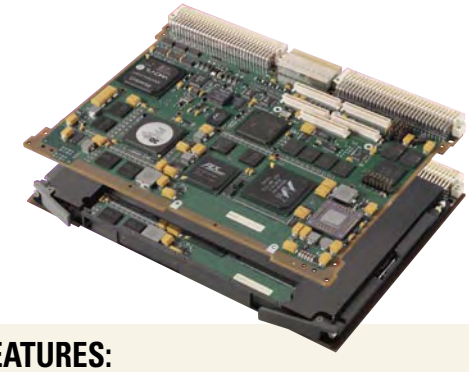
50 Tice Boulevard
Woodcliff Lake, NJ 07677-7645
Tel: 800-368-2738 • Fax: 201-391-2899

Octegra3

www.radstone.com

Octegra3 is the third generation in Radstone's Octegra product family. It represents a leap forward in performance, providing a technology insertion upgrade path from previous generations.

The flexible video architecture of Octegra3 allows system designers to deliver multiple sensor images to the user, bringing vital situational awareness to the point of use and enabling superior decision-making performance. Applications may select from up to eight video inputs, and the video input mezzanine philosophy allows an application-specific mix of input formats.



FEATURES:

- State-of-the-art graphics performance
- Dual independent display capability
- Flexible video streaming architecture
- Video extensions mezzanine capability
- 6U VME form factor
- Available in five ruggedization levels: air-cooled to extended temperature conduction-cooled

For more information, contact: sales@radstone.com

RSC #6902 @www.vmebus-systems.com/catalogrsc

Annapolis Micro Systems, Inc.
190 Admiral Cochrane Drive, Suite 130
Annapolis, MD 21401
Tel: 410-841-2514 • Fax: 410-841-2518

24 GSPS A/D CPD

www.annapmicro.com

The Annapolis COTS Turnkey 24 GSps (Giga Samples per second) Analog to Digital Collection, Processing, and Distribution (CPD) System clocks and synchronizes up to 16 channels of 1.5 GSps A/D input (with 8-bit resolution) or up to eight channels of 3.0 GSps A/D input (with 8-bit resolution), provides user configurable continuous sustained processing for all 24 GSps, and streams all the data out to disk in real time. The system consists of our A/D Clock Sync Distribution Boards, one or more dual 1.5 GSps A/D boards, one or more processing intensive WILDSTAR II Pro processing boards, one or more of our high-performance WILD output cards (including Fibre Channel 2), and a host processor board, all residing in a VME chassis.

The system is user programmable, configurable, and fully scalable to project requirements. Up to five Xilinx Virtex II Pro FPGAs per VME slot provide ample user programmable processing power. All the elements of the system are available from Annapolis as Commercial-Off-the-Shelf (COTS) products. Our A/D Clock Sync Distribution Board can generate a high-precision clock or accept a single-ended or differential input clock provided by the user. All the A/D channels are triggered at the same time and sample the data on the same clock. Preliminary measurements on the A/D Clock Sync Board indicate periodic jitter is less than 2 ps. Clock Skew is ±5 ps. Cycle-to-Cycle jitter is approximately 2.6 ps. TIE jitter time is approximately 1.0 ps. peak-to-peak jitter is 12.5 ps. Our Dual 1.5 GSps A/D I/O card provides up to two channels of 1.6 GHz or one channel of 3.0 GHz sampled data with 8-bit resolution. It has a Xilinx Virtex II Pro 70 FPGA and choice of input options, including balun, differential, transformer, and transistor.

FEATURES:

- Clock and synchronize up to 16 channels of 1.5 GSps with 8-bit resolution
- Continuous real-time data collection at up to 24 GSps
- Continuous real-time data processing of full 24 GSps
- Full bandwidth distribution of raw and processed data
- COTS turnkey system – user configurable and scalable
- WILDSTAR II Pro for VME has up to three Xilinx Virtex II Pro 70 or 100 FPGAs
- WILDSTAR II Pro for VME carries one or two I/O cards – up to five FPGAs per slot
- Fibre Channel 2, WILDSTAR data port, GigE, and other I/O available
- Full CoreFire FPGA application support with more than 800 IP cores
- Achieve world-class performance – WILD solutions outperform the competition
- Includes one-year hardware warranty, software updates, and customer support
- Training classes and application support also available

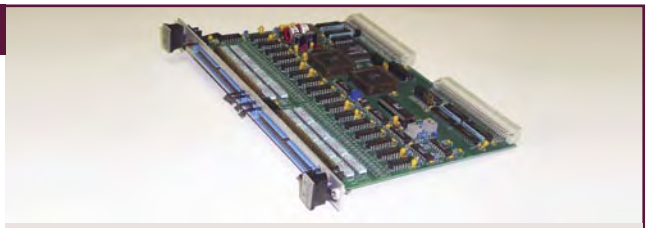
For more information, contact: wfinfo@annapmicro.com

RSC #70 @www.vmebus-systems.com/catalogrsc

Precision Analog Systems
7540 NW 5th Street, Suite 2
Plantation, FL 33317
Tel: 954-587-0668 • Fax: 954-587-0665

PAS 9737/AI

www.precisionanalog.com



The PAS 9737/AI provides 64 analog input channels multiplexed into a scanning, 16-bit analog-to-digital converter. Low-pass filters are provided for the analog input signals, with four different cutoff frequencies available. Digitized analog data is available to the VMEbus through a dual ported RAM interface that can be read while the card continues scanning. It supports 32-bit data reads, enabling a single VME transfer to read two converted values. The PAS 9737/AI also supports VME systems with A16, A24, or A32 addressing.

Additional features include an ID PROM, a control and status register, and a scan configuration register.

FEATURES:

- 64 differential analog input channels multiplexed into a 16- bit, 100 kHz analog-to-digital converter
- Input ranges of ±10 V or ±10.24 V are available with a programmable gain amplifier with gains of 1-16
- Analog inputs are overvoltage protected with power on or off
- Optional low-pass filters with corner frequencies of 10, 50, 100, or 500 Hz
- Card continuously scans selected channels and stores digitized results in dual port RAM
- Analog inputs terminate via a pair of 64-position mass termination connectors or DB78 sub-miniature connectors as an option

For more information, contact: info@precisionanalog.com

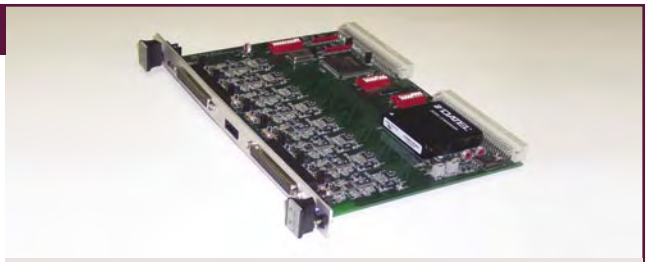
RSC #7101 @www.vmebus-systems.com/catalogrsc

Data acquisition | VME/VXS/VXI product directory | 2005

Precision Analog Systems
7540 NW 5th Street, Suite 2
Plantation, FL 33317
Tel: 954-587-0668 • Fax: 954-587-0665

PAS 9782/GEN

www.precisionanalog.com



The PAS 9782/GEN is a VMEbus, eight-channel function generator. Each channel contains a Direct Digital Synthesis (DDS) chip that can be programmed to generate sine wave output signals. This DDS device is a numerically controlled oscillator, employing a phase accumulator, sine look-up table, and 10-bit D/A converter. The input clock frequency to the DDS chips is 2 MHz, which provides a resolution of 0.000465 Hz and a maximum output frequency of approximately 30 kHz.

A programmable gain amplifier is provided on each channel, allowing full scale output ranges from ±1 V to ±10 V. TTL and open drain FET outputs are also provided.

FEATURES:

- Eight-channel DDS waveform generator
- Each channel provides sine wave, TTL square wave, and open drain FET outputs
- Programmable gain amplifier per channel provides sine wave output of ±10, ±5, ±2, or ±1 V peak-to-peak
- Two independent 32-bit frequency registers control each output channel's frequency
- Two independent 12-bit phase offset registers control each output channel's phase
- Output frequency resolution of 0.000465 Hz, with 3 dB corner frequency of approximately 30 kHz

For more information, contact: info@precisionanalog.com

RSC #7102 @www.vmebus-systems.com/catalogrsc

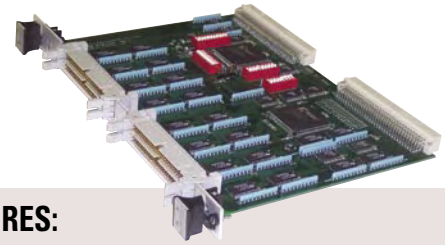
Precision Analog Systems
7540 NW 5th Street, Suite 2
Plantation, FL 33317
Tel: 954-587-0668 • Fax: 954-587-0665

PAS 9797/DIO

www.precisionanalog.com

The PAS 9797/DIO is a VMEbus, 160-channel, TTL digital input/output card. The 160 channels are arranged as 20 each, byte-wide bidirectional data ports. Each port consists of an 8-bit output data register with output enable and an 8-bit input buffer. The input buffers always monitor the state of the I/O lines, and the output registers can either drive the I/O lines or be set to high impedance states.

Each block of 40 channels is terminated on a 50-position shrouded header. Four of these headers are provided at the front panel to terminate the 160 channels. Alternate versions of this card support VME interrupts or reduced channel count.



FEATURES:

- PAS 9797/DIO provides 160 general-purpose I/O lines, arranged as 20 each, byte-wide bidirectional data ports
- Input/output lines are terminated via four 50-pin shrouded headers at the front panel
- All output signals have high-current, 64 mA, sink current capability
- Supports VME data transfers of D32, D16, and D8; DIP switches enable selection of VME addressing of A32, A24, or A16
- PAS 9796/DIO provides 128 general-purpose I/O lines, eight interrupt input lines, and eight flag output lines
- PAS 9795/DIO provides 64 general-purpose I/O lines, four interrupt input lines, and four flag output lines

For more information, contact: info@precisionanalog.com

RSC #7201 @www.vmebus-systems.com/catalogrsc

VME/VXS/VXI product directory | 2005 | Data acquisition

Precision Analog Systems
7540 NW 5th Street, Suite 2
Plantation, FL 33317
Tel: 954-587-0668 • Fax: 954-587-0665

PAS 9723/AI

www.precisionanalog.com

The PAS 9723/AI is a VMEbus, 32-channel, 12-bit, simultaneous sampling analog input card. Differential input instrumentation amplifiers are provided to buffer the 32 inputs. Each amplifier drives a corresponding sample and hold stage, which, upon receipt of a common trigger signal, "freezes" the output of the amplifier. All amplifiers have a gain of 1, however, gain setting resistors can increase the front-end gain by as much as 1,000 to 1.

Sample and Hold (S & H) stages are followed by a 32-channel scanning multiplexer driving a 12-bit ADC. Output values from the ADC are stored in a dual-port memory, providing low-latency VMEbus access.

FEATURES:

- 32 simultaneous S & H analog voltage input channels
- 32-channel scanning analog multiplexer and 12-bit analog-to-digital converter follow the S & H stage
- Instrumentation amplifier per channel, with resistor programmable gain
- Selectable input voltage ranges of: ±10.24 V, ±5.12 V, 0 to 10.24 V, and 0 to 5.12 V
- Analog inputs terminate via a pair of DB37 connectors, and external sync terminates on a coax connector at the front panel
- Supports A32, A24, A16 VME addressing, selectable with DIP switches; VME data transfers are D16 slave

For more information, contact: info@precisionanalog.com

RSC #7202 @www.vmebus-systems.com/catalogrsc

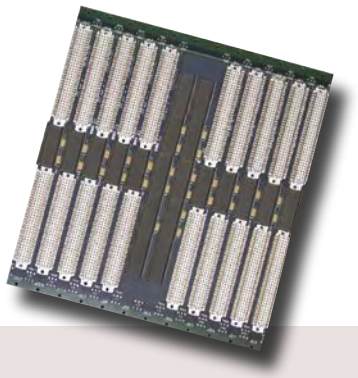
Carlo Gavazzi Computing Solutions

10 Mupac Drive
Brockton, MA 02301
Tel: 800-926-8722 • Fax: 508-588-0498

VITA 41.x

www.gavazzi-computing.com

Carlo Gavazzi's VXS Switch Fabric backplanes are designed for high-speed switch fabrics and maintain J1 and J2 connections to support legacy VME64x cards. The VXS backplane replaces the 95-pin J0 connector of VME64x with a MultiGig RT-2 high-frequency connector for serial data traffic. This 12-slot VXS backplane is set up in a dual star configuration with two fabric switch slots and 10 VME64x payload slots. Each payload slot supports two 4x serial links. One serial link is wired to the first switch slot and the other serial link is wired to the second switch slot. The two switch slots are designed with Inter-Switch links.



FEATURES:

- 12-slot VITA 41.0 VXS backplane with 10 VME64x payload slots and two switch fabric slots
- Dual star configuration
- Inter-Switch links
- SMT passive termination
- Decoupling capacitors
- Passive ABG option

For more information, contact: info@gavazzi-computing.com

RSC #7301 @www.vmebus-systems.com/catalogrsc

Electronic packaging | VME/VXS/VXI product directory | 2005

Elma Bustronic

4350 Grimmer Blvd.
Fremont, CA 94538
Tel: 510-490-7388 • Fax: 510-490-1853

VME Backplanes

www.bustronic.com

Elma Bustronic is the industry leader in standard and customized VME-based backplanes. Models include versions in VME, VME64x, VXI, and VXS architectures.

Elma Bustronic has the widest range of VME-based backplanes in the industry. The company is renowned for its experienced design team that provides customized VME backplanes with the utmost quality, expertise, and completion time. Elma Bustronic uses simulation/characterization tools to optimize their designs.

FEATURES:

- VME – 3U and 6U heights; J1 + J2 monolithic, J1 only, J2 only, J0 only, and power and ground types; 2-21 slots
- VME64x – 6U and 7U heights; 7U versions meet VITA 1.7 High Current specification; 2-21 slots
- VXS – 6U and 7U heights; Star, Dual Star, and Switchless Mesh topologies; 5 (two versions), 8, 12, and 20-slot sizes
- VXI – 6U (C) and 9U (D) heights; 5-13 slot sizes
- Optimized via signal integrity studies

For more information, contact: sales@elmabustronic.com

RSC #7302 @www.vmebus-systems.com/catalogrsc

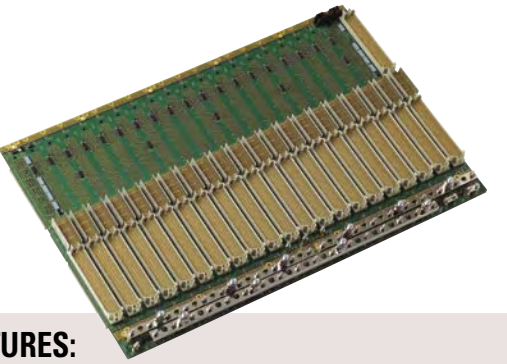
Hartmann Elektronik GmbH
Motorstrasse 43
Stuttgart, D-70499 DE
Tel: +49-7111-3989-0 • Fax: +49-7118-6611-91

HARTMANN ELEKTRONIK
A Phoenix Mecano Company

VME64x 6.5U ADC

www.hartmann-elektronik.com

The VME64x is an extension of the VME family according to ANSI/VITA 1.1-1997 and permits 64-bit data traffic. Automatic daisy chain wiring with OR gates makes manual setting of jumpers unnecessary. ALL Hartmann VMEbus boards are based on the HIGH-SPEED DESIGN concept. Shielding of each individual signal line assures minimal coupling and, therefore, guarantees trouble-free operation. Low reflection is achieved by means of uniform signal line surge impedance. The board thickness of 4.3 mm guarantees mechanical stability during assembly insertion. Power is supplied via screw connections and terminal bars. It is also available without the J0 connector.



FEATURES:

- Available as a 2, 5, 7, 9, 12, or 21-slot backplane, with or without a J0 connector; automatic daisy chain, activ terminated
- +5 V 7 +3.3 V/GND is supplied via terminal bars
- Outer layers designed as shielded areas (best HF); HF coupling of card, rack, and system ground
- Maximum loading of terminal bar = 200 A; screw = 25 A
- Termination: activ -20 °C up to 85 °C
- Impedance checked transfer characteristics

For more information, contact: info@hartmann-elektronik.de

RSC #7401 @www.vmebus-systems.com/catalogrsc

Elma Electronic, Inc.
44350 S. Grimmer Blvd.
Fremont, CA 94538
Tel: 510-656-3400 • Fax: 510-656-3783

bustronic
Elma Bustronic

Integration

www.elma.com

At last, a complete embedded packaging solution that's simple and reliable! With more than 40 years' experience in electronic packaging, Elma has long been the industry expert in every segment of electronic production. You'll work with an experienced sales engineer who will see your project through design, prototype, production, and integration. Utilize our testing and verification resources to make sure your application meets agency standards, and your specifications. With everything done in one place, you save time and money on logistics. All you have to do is sit back and watch all the pieces fall into place.

FEATURES:

- Shock and vibration testing
- EMC and NEBS testing
- Thermal analysis
- FCC Class A and B certification
- UL, CSA, CE certification
- NEBS Level III certification

For more information, contact: suzanab@elma.com

RSC #7402 @www.vmebus-systems.com/catalogrsc

Annapolis Micro Systems, Inc.
190 Admiral Cochrane Drive, Suite 130
Annapolis, MD 21401
Tel: 410-841-2514 • Fax: 410-841-2518

1.5 GHz A/D Board

www.annapmicro.com

Annapolis Micro Systems is a world leader in high-performance COTS FPGA-based processing for radar, sonar, SIGINT, ELINT, digital signal processing, FFTs, communications, software radio, encryption, image processing, prototyping, text processing, and other processing intensive applications.The Annapolis Dual 1.5 GHz A/D I/O card provides two channels of 1.5 GSps input (with 8-bit resolution) or one channel of 3.0 GSps input (with 8-bit resolution). The board has two Max108 8-bit ADCs, each one fed by its own pair of differential signals. The differential clock signals coming into the board can provide identical clocks to both A/Ds for dual 1.5 GSps channels or an inverted clock to one of the A/Ds to interleave the data for a single 3.0 GSps channel. Multiple I/O cards can be synched together via the Annapolis Clock Sync Distribution Board, as in the 24 GSps A/D Collection, Processing and Distribution (CPD) system. The Xilinx Virtex II Pro 70 on the board provides user-configurable, real-time continuous sustained processing of the full data stream. Up to two of these I/O cards can reside on the Annapolis WILDSTAR II or WILDSTAR II Pro FPGA-based VME and PCI bus boards, which provide up to 30 million more user reprogrammable FPGA gates for onboard processing.

Our boards run on many different operating systems. We support our board products with a standardized set of drivers, APIs, and VHDL simulation models. We offer training, including customized application development and customer support. Develop applications with CoreFire (more than 800 cores), which transforms the FPGA development process, making it possible for theoreticians to easily build and test their algorithms on the real hardware that will be used in the field. The combination of our COTS hardware and CoreFire lets our customers make massive improvements in processing speed, while achieving significant savings in size, weight, power, person-hours, dollars, and calendar time-to-deployment.

FEATURES:

- Two MAX 108 8-bit A/D converters – two 1.5 GSps channels or one 3 GSps channel
- Two sets of differential input signals – one for each A/D
- Differential clock input – Synchronize or interleave the two data streams
- Up to 6 GBps I/O bandwidth to WILDSTAR II Pro motherboard I/O slot
- Xilinx Virtex II Pro XC2V70 FPGA for user reprogrammable processing
- Heat sink on FPGA
- Host software: Win NT, 2000, XP, Linux, VxWorks, Solaris, MacOS, DECAlpha, and SGI
- Full CoreFire board support package for fast and easy application development
- VHDL model, including some source code
- Save time and effort and reduce risk with COTS boards and software
- Achieve world-class performance – WILD solutions outperform the competition
- Includes one-year hardware warranty, software updates, and customer support; training available

For more information, contact: wfinfo@annapmicro.com

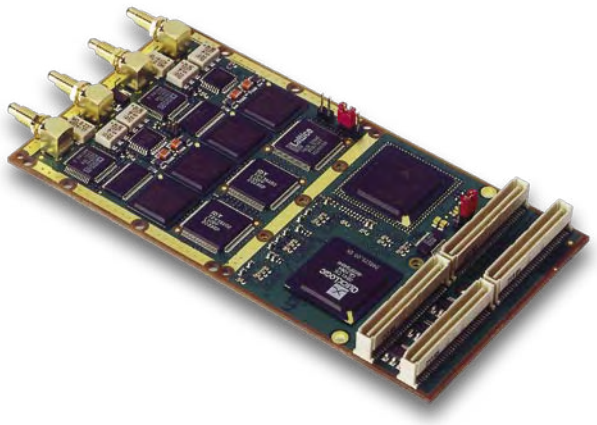
RSC #75 @www.vmebus-systems.com/catalogrsc

Pentland Systems
MacMillian Rd
Livingston, EH54 7DF GB
Tel: +44-1506-464666 • Fax: +44-1506-463030

RAD-2 Digital Receiver

www.pentlandsys.com

The RAD-2 Digital Receiver PMC is the leading solution for acquisition of high-speed analog signals in radar, Software Defined Radio, and signal intelligence applications. Dual 105 MSps analog acquisition channels are augmented by substantial FPGA resources and up to 16 individual down-conversion channels provided by four GC4016 down converters. High bandwidth transfer over 64-bit, 66 MHz PCI is enabled using powerful onboard DMA engines. Extensive support for system-level functionality, such as built-in-test, is also provided. OS drivers are available for VxWorks and Linux. Path-to-rugged design is inherent in the product range, with versions available for extended temperature, shock and vibration, and air-cooled and conduction-cooled environments. The RAD-2 is purposefully designed for radar, Software Defined Radio, and signal intelligence markets. Unique functionality such as clock de-skewing is aimed at relieving the problems encountered in the design of complex, multiple radiating element radars. In-system reconfigurable down-conversion and filtering functionality supports the objective of Software Defined Radio. With post-acquisition DSP, the RAD-2 effectively increases the processing density of the overall system. The RAD-2 is designed path-to-rugged in accordance with the ANSI/VITA Conduction Cooled PMC specification and accommodates central stiffening bars on the host board. Maximum power dissipation with an XC2V1000 FPGA executes projected algorithms in 7 W. A cost-effective commercial specification version of the RAD-2 is available for prototyping in benign environments. Built-in-test support is fundamental in the RAD-2 product family, and extensive capacity is available for Power-Up, Background, Non-Intrusive, and Intrusive BIT. The RAD-2 is also capable of supporting a boot PROM containing BIT control functions for automatic execution of a configurable set of BIT routines on power-up.



FEATURES:

- Dual Channel 105 MSps 14-bit analog-to-digital conversion
- Wide bandwidth (>200 MHz)
- High SNR (>12 ENoBs)
- SINAD > 72 dB
- THD > 82 dB
- Low risk ruggedization specifically designed for rugged environments; easy translation from commercial prototype to rugged production
- Clock de-skew circuits remove phase error in the analog domain, correct cable mismatch and quadrature imbalance, and are available on synchronous or independent clocks
- FPGA resource for custom DSP with 90 percent of 3 million gate Virtex II accessible; firmware development kit also available with custom design service offered
- Comprehensive BIT with onboard DACs support testability of both analog and digital subsystems for PBIT, BBIT, and IBIT modes
- Multiple DMA engines maximize use of PCI 2.2 interface and are capable of supporting continuous capture at the board's maximum 420 MBps

For more information, contact: sales@pentland.co.uk

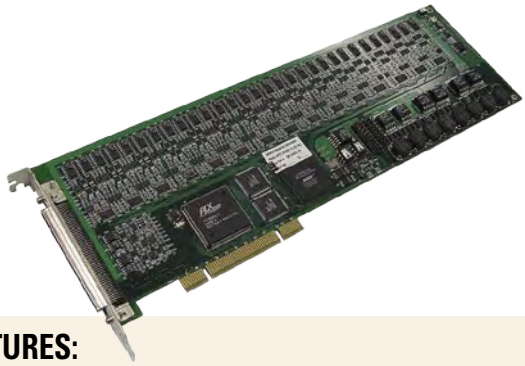
RSC #76 @www.vmebus-systems.com/catalogrsc

General Standards Corp.
8302-A Whitesburg Drive
Huntsville, AL 35802
Tel: 800-653-9970 • Fax: 256-880-8788

General Standards

PCI-24DSI32 www.generalstandards.com/delta-sigma.php

Low noise, 24-bit resolution, low phase distortion, and multi-board synchronization make this product ideal for state-of-the-art sonar and noise monitoring applications. A/D conversions on multiple boards can be synchronized and phase-locked. Input bandwidth is from DC to 80 kHz. Sample rates are adjustable from 2 KSps to 200 KSps, and the input range is software selectable as ±2.5, ±5, or ±10 V. Internal autocalibration networks permit periodic calibration to be performed without removing the board from the system. This board is available on PCI, PMC, CompactPCI, and PC104-*Plus*. Windows, Linux, and VxWorks drivers are available.



FEATURES:

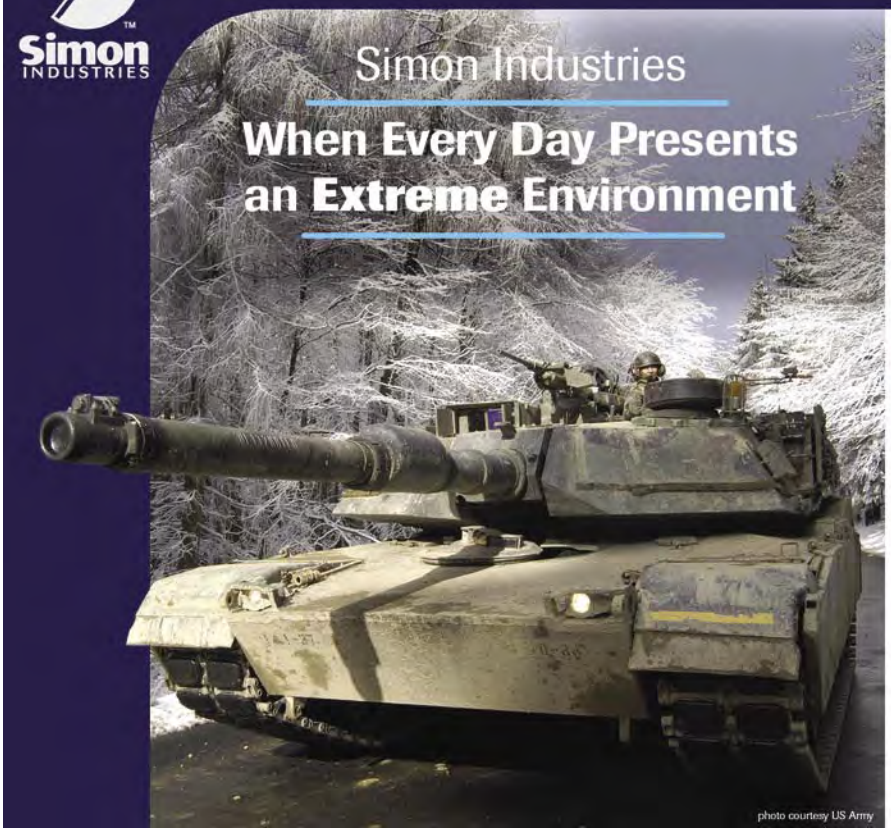
- 32 differential, 24-bit analog input channels
- Delta-Sigma converter per channel
- Software-selectable input ranges: ±2.5, ±5, or ±10 V
- Low phase skew; 55 ns (0.1° at 5 kHz)
- Low power consumption – 12 W typical; only +5 Vdc required from PCI bus
- On-demand autocalibration ensures DC offset precision as well as AC performance

For more information, contact: solutions@generalstandards.com

RSC #7701 @www.vmebus-systems.com/catalogrsc

Simon™ INDUSTRIES

Simon Industries
When Every Day Presents an Extreme Environment



Conduction-Cooled Heat Frames:
Simon Industries is the One-Stop Solution

- complete frame or system design
- 3D solid modeling
- thermal modeling using FEA & CFD
- 2D & 3D assembly drawings
- turn-key manufacturing from prototype to high volume production

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Creative Electronic Systems
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Grand-Lancy 1/Geneva, 1212
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RIO4 8070/RIO4 8076

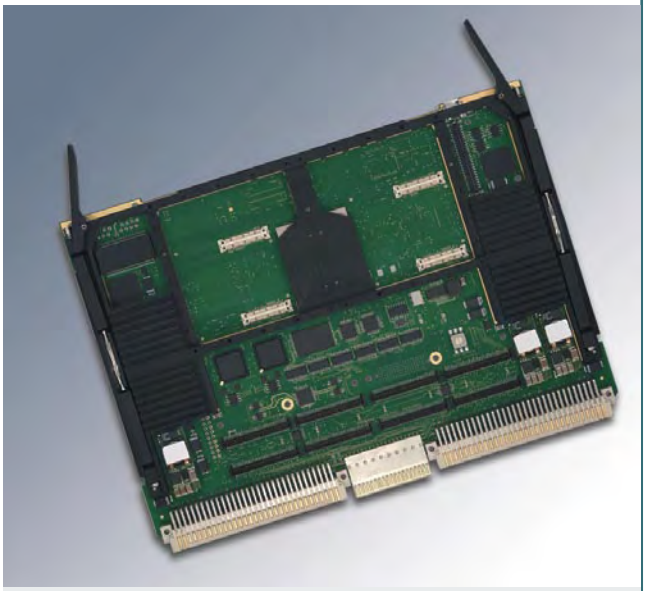
www.ces.ch

The RIO4 8070 and the RIO4 8076 are designed for the most demanding applications, which combine very high processing power along with harsh environment conditions. Typical targets include UAVs, radars, and military aircraft. The RIO4 8070 shares the same PCB as the RIO4 8076, although the RIO4 8076 is the full conduction-cooled specification model.

The RIO4 8070 and the RIO4 8076 are designed for ultimate high-throughput acquisition combined with real time data processing. Their computing elements use the latest PowerPC G4 processor, an FPGA, and a set of high-speed serial links handled by a unique CES multiport control logic incorporating user-controlled bandwidth. Each board hosts two PMC sites, which can be powered ON/OFF independently. Each board also hosts a user-dedicated Virtex-II Pro FPGA to handle user-specific applications. The boards are equipped with a full Secure Cells package for monitoring current, voltage, temperature, bus bandwidth, etc., and enabling reload, reconfiguration, and bypass decisions in real time.

CES, as a system company, designs in-house, both hardware and software elements comprising a Board Support Package (BSP) and offers the package as a bundle, where all of the available hardware functions are supported by software. The RIO4 8070 and the RIO4 8076 are available with the general-purpose Linux® toolkit, as well as with CES extended BSPs for VxWorks® and Integrity®. CES AE 653 BSPs are also available. When equipped with two CPUs, the board can run two different operating systems (Linux® on one CPU, and VxWorks® on the other).

Related CES conduction-cooled models include:
- PEB 6426 – PMC extension board
- MFCC 8446 – Multifunction computing core PPMC
- GPIO 8406 – User-programmable I/O PMC
- MIL-5364 – MFCC-based MIL-STD-1553B PMC
- ARINC 8429 – ARINC 429 PMC
- CAN 8428 – CANbus PMC
- ACS 6060 – ARINC 600 Chassis



FEATURES:

- Single or dual computing node
- Each node equipped with a PowerPC G4 at maximum available frequency, and a Virtex-II Pro FPGA with private ultra-high-speed SSRAM
- Two Gigabit Ethernet interfaces
- Two PMC sites with RocketIO interface
- VME 64x 2eSST AND two separate PCI buses
- VXS or PCI interface on P0
- Onboard Virtex-II Pro FPGA for user-defined applications
- Onboard NAND Flash memory with Fast File System
- Backplane real-time distribution logic
- Full secure cells real-time reconfiguration logic

Red Rock Technologies, Inc.
14429 N. 73rd Street
Scottsdale, AZ 85260
Tel: 480-483-3777 • Fax: 480-483-8885

RRT-1DVW-LW

www.RedRockTech.com

SCSI DVD-RW drive

This module provides a transparent interface from the Ultra Wide SCSI LVD bus to the low-profile DVD-RW ATAPI interface drive. Modes of operation include DVD-RW, DVD-ROM, CD-RW, CD-R, and CDROM.

The DVD-RW drive may be accessed as a standard SCSI device. SCSI bus signals are available at P2 and front panel connectors. Only power is taken from the VMEbus.

These modules provide a high-capacity field replaceable unit for removable DVD-RW, DVD, CD-RW, and CDROM media. SCSI termination is provided within the unit. The SCSI interface is fully configurable for 8-bit, single-ended and SCSI-2 compatibility.

FEATURES:

- Enables use of removable, rewritable, durable DVD-RW and CD-RW media in the field
- VMEbus form factor in one 6U slot; CompactPCI version available
- Ultra Wide SCSI LVD interface available at front panel and P2 connectors
- Can be configured for 8-bit, single-ended and/or SCSI-2 operation, thus supporting legacy systems
- Front panel status and activity LEDs
- P2 cable adapter panel available

For more information, contact: info@redrocktech.com

RSC #7901 @www.vmebus-systems.com/catalogrsc

Mass storage | VME/VXS/VXI product directory | 2005

Red Rock Technologies, Inc.
14429 N. 73rd Street
Scottsdale, AZ 85260
Tel: 480-483-3777 • Fax: 480-483-8885

RRT-1SP-LW

www.RedRockTech.com

SCSI to PCMCIA adapter

The SCSI to PCMCIA adapter provides a transparent interface from the Ultra Wide SCSI LVD bus to removable PCMCIA storage devices and optionally to a fixed 2.5" ATA Flash or hard drive. PCMCIA devices and optional 2.5" drive may be accessed as separate SCSI Logical Units. SCSI bus signals are available at P2 and front panel connectors. Only power is taken from the VMEbus. These modules provide a high-capacity field replaceable unit capable of withstanding higher shock and vibration environments. SCSI termination is provided within the unit. The SCSI interface is fully configurable for 8-bit, single-ended and SCSI-2 compatibility.

FEATURES:

- Two hot swappable PCMCIA card slots plus an optional fixed ATA hard drive or Flash drive
- VMEbus form factor in one 6U slot; CompactPCI version available
- Ultra Wide SCSI LVD interface available at front panel and P2 connectors
- Can be configured for 8-bit, single-ended and/or SCSI-2 operation, thus supporting legacy systems
- Front panel status and activity LEDs
- P2 cable adapter panel available

For more information, contact: info@redrocktech.com

RSC #7902 @www.vmebus-systems.com/catalogrsc

Red Rock Technologies, Inc.
14429 N. 73rd Street
Scottsdale, AZ 85260
Tel: 480-483-3777 • Fax: 480-483-8885

RRT-1SFA-LW

www.RedRockTech.com

SCSI Flash drive

Red Rock Technologies' RRT-1SFA-LW provides a transparent interface from the Ultra Wide SCSI LVD bus to 2.5" ATA Flash drives.

Capacities up to 64 GB are available in a single 6U VMEbus slot. Drives are addressable as one large disk or may be accessed as separate SCSI Logical Units. SCSI bus signals are available at P2 and front panel connectors.

These modules provide a high-capacity field replaceable unit capable of withstanding higher shock and vibration environments. SCSI termination is provided with the unit.

The SCSI interface is fully configurable for 8-bit, single-ended and SCSI-2 compatibility.

FEATURES:

- Capacity up to 64 GB; no additional software is required for operation as a SCSI bootable drive
- VMEbus form factor in one 6U slot; CompactPCI version available
- Ultra Wide SCSI LVD interface available at front panel and P2 connectors
- Can be configured for 8-bit, single-ended and/or SCSI-2 operation, thus supporting legacy systems
- Front panel status and activity LEDs
- P2 cable adapter panel available

For more information, contact: info@redrocktech.com

RSC #8001 @www.vmebus-systems.com/catalogrsc

VME/VXS/VXI product directory | 2005 | Mass storage

Red Rock Technologies, Inc.
14429 N. 73rd Street
Scottsdale, AZ 85260
Tel: 480-483-3777 • Fax: 480-483-8885

RRT-1SHA-LW

www.RedRockTech.com

SCSI hard drive

Model RRT-1SHA-LW provides a transparent interface from the Ultra Wide SCSI LVD bus to 2.5" ATA hard drives.

Capacities up to 240 GB are available in a single 6U VMEbus slot. Drives are addressable as one large disk or may be accessed as separate SCSI Logical Units. SCSI bus signals are available at P2 and front panel connectors.

These modules provide a high-capacity field replaceable unit capable of withstanding higher shock and vibration environments.

SCSI termination is provided with the unit. The SCSI interface is fully configurable for 8-bit, single-ended and SCSI-2 compatibility.

FEATURES:

- Capacity of up to 240 GB
- VMEbus form factor in one 6U slot; CompactPCI version available
- Ultra Wide SCSI LVD interface available at front panel and P2 connectors
- Can be configured for 8-bit, single-ended and/or SCSI-2 operation, thus supporting legacy systems
- Front panel status and activity LEDs
- P2 cable adapter panel available

For more information, contact: info@redrocktech.com

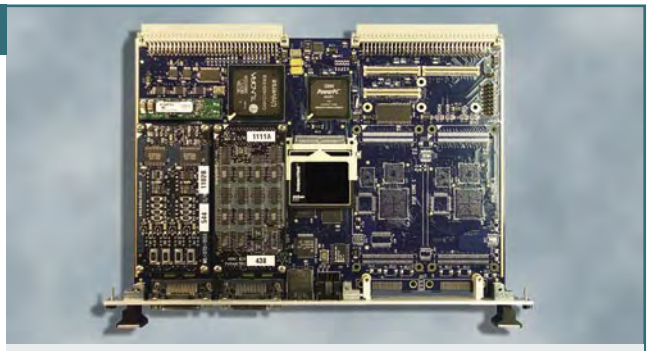
RSC #8002 @www.vmebus-systems.com/catalogrsc

Ballard Technology, Inc.
3229-A Pine Street
Everett, WA 98201
Tel: 800-829-1553 • Fax: 425-339-0915

OmniBus VME

www.ballardtech.com

Ballard's OmniBus VME avionics databus interfaces set a new standard for flexibility and power. Available with multiple dual-redundant MIL-STD-1553 databuses (up to eight) or with a mix of protocols (1553, ARINC 429/708/717, CSDB, avionics discretes, serial, etc.), they suit a broad range of applications. Extensive capability is provided for easy-to-use simulation, monitoring, and testing. An onboard PowerPC® processor can be programmed to off-load or run independently of the VME processor. The OmniBus VME may run locally through the backplane, remotely via Ethernet, or standalone from user code embedded on the PowerPC. A PrPMC-compatible site provides additional flexibility. OmniBus is also available for PCI, CompactPCI, and Ethernet/USB.



FEATURES:

- Up to eight dual-redundant MIL-STD-1553 buses
- Single and multi-terminal models
- BC, 32 RTs, bus monitor, error injection
- IRIG time-tags/synchronization
- Ethernet (10/100Base-T) and serial (RS-232)
- PowerPC user processor/CompactFlash socket

For more information, contact: sales@ballardtech.com

RSC #8101 @www.vmebus-systems.com/catalogrsc

Hybricon Corporation
12 Willow Road
Ayer, MA 01432
Tel: 1-877-HYBRICON • Fax: 978-772-2963

Liquid-Cooled Enclosure

www.hybricon.com

Hybricon Corporation's military COTS liquid-cooled enclosure solution was designed for optimum cooling through the use of an air-to-water heat exchanger. Three AC fans in a series mounted above the card cage and a single heat exchanger fan provide a simulated average airflow of 225 LFM per slot. The airflow path is arranged in a closed loop through an air-to-water heat exchanger, which uses a 50/50 ethylene glycol water mixture delivered at 3 GPM and 10 PSI. The enclosures are configured with a 21-slot VME64x backplane mounted on slides for easy access.

FEATURES:

- Air-to-water heat exchange
- Shock isolated system
- Munson road tested
- Low acoustic noise
- 750 W embedded power supply
- Patented CoolSlot air deflecting card guides eliminate hot spots and improve board cooling by as much as 50 percent

For more information, contact: info@hybricon.com

RSC #8102 @www.vmebus-systems.com/catalogrsc

Hypertronics Corporation
16 Brent Drive
Hudson, MA 01749
Tel: 978-568-0451 • Fax: 978-568-0680

VME64x Connector

www.hypertronics.com

Ruggedized VME64x connectors overcome challenges of harsh environments

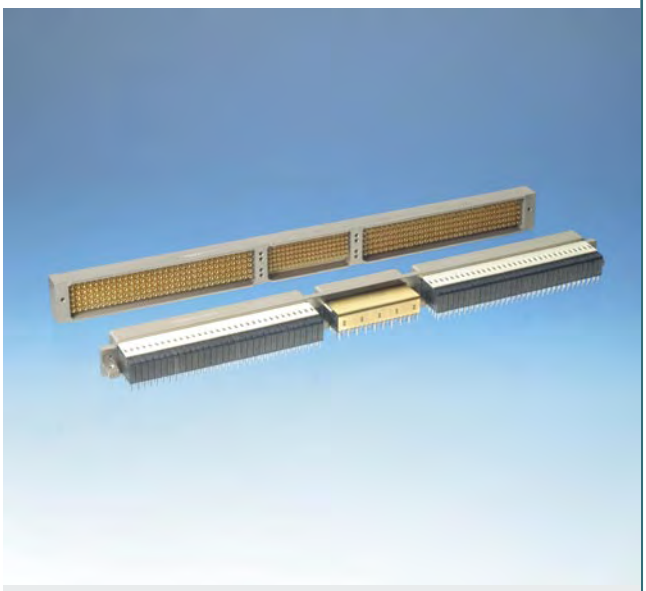
Hypertronics' ruggedized VME64x connectors are designed for use in the most demanding and critical environments such as military, aerospace, and telecommunications applications. The connectors feature both the legendary Hypertac® contact technology, which offers a significantly improved interface for immunity to shock and vibration, as well as aluminum frames that provide ruggedness and conduction cooling. The VME64x interconnect solution contains optimized contact lead traces that are designed for high-speed signal applications.

VME64x connectors are mechanically compliant with IEEE-1101.2-1992, supporting the premier embedded bus architecture. Aluminum frames provide ruggedness and conduction cooling, and keying features ensure proper mating.

The physical demands of critical applications require a higher standard of reliability, and off-the-shelf connectors can't stand up to the rigors of these types of applications where design failure simply is not an option. With the VME64x connector, Hypertronics' engineers have put together a complete solution that removes weakness of the electrical interface from the standard VME COTS architecture, reducing costs of development, manufacturing, and ownership.

VME64x connectors benefit from the highly reliable Hypertac® contact technology, which offers a significantly improved interface for immunity to shock and vibration and low mating forces. Hypertac contact technology features a hyperboloid-shaped basket of individual spring wires that deliver the highest level of reliability and performance.

Hypertronics offers both standard and customizable VME64x solutions. With the VME64x connectors, manufacturers with critical applications are guaranteed a reliable, high-performance connector solution for situations in which the cost of failure is incalculable.



FEATURES:

- Designed for severe environment applications with high levels of shock and vibration
- Mechanically compliant with IEEE-1101.2 -1992
- Optimized lead traces within modules provide superior performance in high-speed signal applications
- Reduced costs of development, manufacturing, and ownership
- Stackable design of high-speed modules features round pins to mate with Hypertac contact
- Hypertac contacts with up to 100,000 mating cycles and low mating forces
- Keying feature guarantees proper mating
- Aluminum frames for ruggedness and conduction cooling
- Shield prevents EMI/RFI
- COTs and custom applications
- Configure and download 3D connector models or 2D drawings for this product

For more information, contact: info@hypertronics.com

RSC #82 @www.vmebus-systems.com/catalogrsc

SBS Technologies

7401 Snaproll NE
Albuquerque, NM 87109
Tel: 505-875-0600 • Fax: 505-875-0400

Rugged VME Systems

www.sbs.com

Featuring the AVC-VME-6000 Series advanced vehicle computers, SBS produces rugged chassis, and rugged electronic boards and components for use in military and space systems. They meet the challenges of extreme temperatures, shock, vibration, EMI, and G-forces.

Featuring ruggedized computing platforms in VME 6U formats, SBS systems are available in dozens of standardized configurations. They include rugged chassis, integrated processors, I/O, signal processing, and power supplies.

Our AVC-VME-6000 Series systems are based on VME 6U-form-factor single board computers and I/O. They feature various rugged SBCs and I/O boards from SBS.

FEATURES:

- AVC-VME-6000 Series Advanced Vehicle Computers are based on VME 6U systems:
  - 5 VME 6U slots
  - 150 W-300 W rugged power supply
  - PPC or Intel-based SBC(s)
  - Flexible I/O options
  - Strong, lightweight casings and subsystems

For more information, contact: info@sbs.com

RSC #8301 @www.vmebus-systems.com/catalogrsc

Elma Electronic, Inc.

44350 S. Grimmer Blvd.
Fremont, CA 94538
Tel: 510-656-3400 • Fax: 510-656-3783

12R107OP9F78N5VGD4

www.elma.com

Elma's new low-weight 7U 12R1 COTS is a rugged chassis with excellent shielding effectiveness, but weighs 20-25 percent less than Elma's previous models. They are designed, manufactured, and tested to meet the demands of military, aerospace, and defense markets, and MIL-STD-167, MIL-STD-810F, MIL-STD-461D, and MIL-STD-901D. They hold 6U x 160 mm or 220 mm cards and are available in 22" and 25" depths or custom sizes. A wide range of backplanes in up to 20 slot sizes is available in VME, VME64x, VXS, CompactPCI, or other architectures.

FEATURES:

- VME/64x, VXS, VXI, and CompactPCI – ideal for airborne applications where weight is premium
- 20-25 percent less weight than comparable rugged chassis 2U-9U heights, in horizontal or vertical orientation options
- Complete EMI/RFI integrity via braided gasketing and honeycomb filtering; rugged chassis shell made of aluminum frames and extruded profiles
- 350-1400 W power supplies; 90-264 Vac input, 47-440 Hz with optional 28/48 Vdc input
- Wide range of backplane options, 2-20 slots, mil-grade components; configurable IO patch panel on rear
- Tested for shock, vibration, and structural integrity; withstands 15 Gs (shock and vibration resistance)

For more information, contact: sasghari01@hotmail.com

RSC #8302 @www.vmebus-systems.com/catalogrsc

Hybricon Corporation

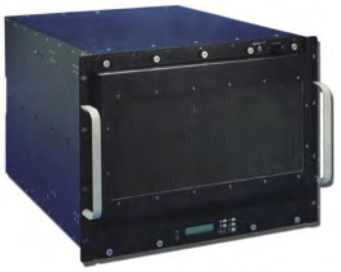
12 Willow Road
Ayer, MA 01432
Tel: 1-877-HYBRICON • Fax: 978-772-2963

Ruggedized Chassis

www.hybricon.com

Hybricon Corporation's ruggedized 8U rackmount enclosures provide robust cooling in a compact stackable design. High-performance cooling supports demanding high power applications, delivering 310 LFM per slot, sufficient cooling for 60 W per slot. Custom versions are available with cooling up to 100 W per slot.

The RME821M enclosures are designed to meet MIL-STD-461 EMI radiated and conducted emissions and susceptibility standards by using gasketing at all seams and 1" thick honeycomb panels at both air intake and exhaust openings. The enclosures are available with 21-slot CompactPCI, VME64x, VME, or VXS backplanes.



FEATURES:

- High-quality ruggedized construction
- Designed to meet military shock, vibration, and EMI standards
- Designed to cool extremely dense CPU and DSP boards, delivering cooling up to 100 W per slot
- Compact 8U size
- Up to 1200 W of embedded power (custom versions support up to 2100 W)
- Extensive chassis monitoring with external Ethernet and RS-232 interfaces

For more information, contact: info@hybricon.com

RSC #8401 @www.vmebus-systems.com/catalogrsc

VME/VXS/VXI product directory | 2005 | Rugged chassis

Radstone Embedded Computing

50 Tice Boulevard
Woodcliff Lake, NJ 07677-7645
Tel: 800-368-2738 • Fax: 201-391-2899

ATR Solutions

www.radstone.com

Radstone liquid-cooled ATR solutions allow cost-effective adaptation to program requirements. With liquid cooling, Radstone can decouple ATR cooling from the limitations of the chassis' immediate environment and push power dissipation levels up to 1 kW.

For applications where a liquid cooling infrastructure already exists, Radstone offers a set of COTS ATR chassis. Lightweight and cost-effective, these chassis connect to the platform's coolant supply by means of quick-release valves.

For self-contained upgrades and original installations, a liquid-cooled ATR can be linked to a separate heat rejection unit, the HRU-1000R.

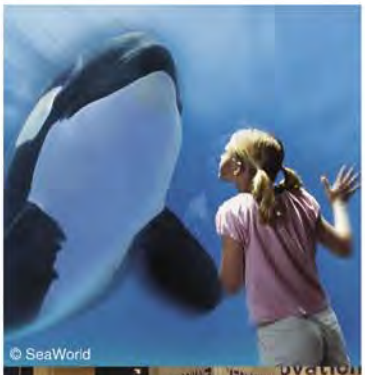
FEATURES:

- Full COTS product set
- Up to 1 kW dissipation
- Accepts legacy and future conduction-cooled boards compliant with IEEE 1101.2 and ANSI/VITA 30.1
- VMEbus and CompactPCI
- Two architectural options: plumbed into existing liquid-cooled infrastructure; or standalone with HRU-1000R heat rejection unit
- Suitable for use on any airborne, ground, or naval platform

For more information, contact: sales@radstone.com

RSC #8402 @www.vmebus-systems.com/catalogrsc

Innovation: Creating and Sustaining Positive Change



AUTOTESTCON 2005

September 26-29, 2005

Renaissance Orlando Resort at SeaWorld, Orlando, Florida

http://www.autotestcon.com

IEEE AUTOTESTCON is the premier annual conference for automatic test, diagnostics and related technologies for military, aerospace and automotive applications. This year — the 41st anniversary of bringing together researchers and practitioners to share the latest innovations in systems readiness — IEEE AUTOTESTCON will offer you the opportunity to network in one of the most complete convention resort destinations in the country.

The technical program will begin Tuesday with a keynote address and plenary session followed by multiple technical tracks through Thursday. The 42,000 square foot exhibit area will offer opportunities to view the latest technology and exciting new products. It's about creating the future — what you need to know for tomorrow, today!

Reasons to make reservations now for AUTOTESTCON 2005:

Meet with exhibitors and other test professionals

See the latest ATE innovations

Learn from a variety of top technical specialists

Celebrate the achievements of Systems Readiness Technology

Be entertained at the SeaWorld Evening Gala

Visit the greatest collection of theme parks in the world

Enjoy a challenging round at the annual golf tournament

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Tour restricted areas at the Kennedy Space Center

IEEE

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SBS Technologies
7401 Snaproll NE
Albuquerque, NM 87109
Tel: 505-875-0600 • Fax: 505-875-0400

VR9 Intel SBC

www.sbs.com

The VR9 is a 6U VMEbus, all-in-one CPU board with an integrated, power-efficient gigahertz processor and dual GigE channels.

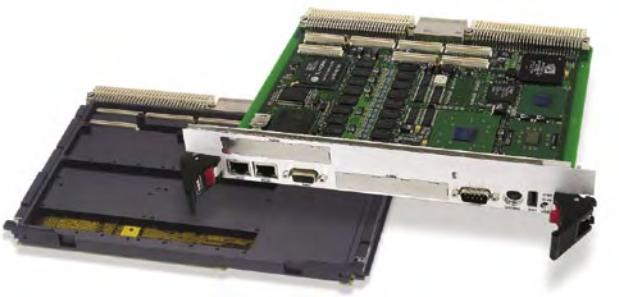
The VR9 is designed to meet the needs of embedded application developers addressing markets such as military and aerospace, imaging, industrial automation, and communications.

Based on the Intel® Pentium® M processor, the VR9 platform is designed to support processor speeds from 600 MHz up to 1.6 GHz. It offers low power consumption, generating minimal heat and eliminating the need for onboard ventilation.

The VR9 provides a unique feature set, including up to 2 GB DDR SDRAM (200) with ECC, three independent onboard PCI buses, support for the VME64x backplane, and two PMC interfaces (64-bit/66 MHz and 32-bit/33 MHz). High level of functional integration (VGA/TFT, GigE, serial interfaces, etc.) within a single slot gives users the freedom to use the PMC interfaces as extensions for their applications. This, combined with a custom specific assembly service, provides optimized price/performance for all kinds of OEM applications.

Versions with front-panel I/O are available in various configurations with and without PMC support. Rugged needs are addressed with optional conduction cooling and an extended temperature range from -40 °C to +65 °C, increased shock and vibration immunity using stiffener bars and wedge locks, and conformal coating. The conduction-cooled VR9 complies to the IEEE Std. 1101.2-1992 and ANSI/VITA 20-2001 specifications.

Special features include two serial channels with flexible RS-232 or RS-422/485 interfacing and an LCD controller. Supported operating systems are Windows® 2000, Windows® XP, QNX, VxWorks®, LynxOS®, Linux®, and others.



FEATURES:

- Intel® Pentium® M processor, 600 MHz to 1.6 GHz
- Two GigE ports, 10/100/1000Base-T front or rear optional
- Two PMC extension slots, one 64-bit/66 MHz and one 32-bit/33 MHz
- Conduction cooling, conformal coating, and extended temperature range options
- High shock and vibration immunity with stiffener bars and wedge locks
- Extensive software support
- Ultra compact, one slot only or two slot with front panel I/O
- Up to 2 GB DDR SDRAM (200) with ECC
- Flash drive up to 1 GB or local 2.5" hard disk
- Ultra ATA/100 onboard, second channel mixed with PMC32/33 rear I/O
- 2x serial I/O with FIFOs; RS-232/422/485 interface
- USB 2.0 ports, one front and two rear

For more information, contact: info@sbs.com

RSC #86 @www.vmebus-systems.com/catalogrsc

Dynatem, Inc.
23263 Madero, Suite C
Mission Viejo, CA 92691
Tel: 800-543-3830 • Fax: 949-770-3481

DPM

www.dynatem.com

The DPM is a VMEbus (and VME64) compatible platform based on the Intel® low-power Pentium® M (Dothan) processor. The DPM takes advantage of the Pentium M's low power consumption as a rugged Single Board Computer (SBC) and it is optionally available as an IEEE 1101.2-compliant, conduction-cooled VMEbus module with wedge locks and a full-board heat sink for high shock/vibration environments and temperature extremes.

The 855GME Graphics Memory Controller Hub (GMCH) and 6300ESB I/O Controller Hub (ICH) chipset supports PCI-X expansion, an integrated VGA/DVO interface, USB 2.0, ATA/100, and Serial ATA (SATA). A DVI-I connector, two USB 2.0 ports, a 10/100Base-Tx interface, and a COM port are all accessible from the front panel. Onboard CompactFlash permits single-slot booting. Two VITA 31.1-compliant, 10/100/1000Base-Tx ports are routed to the backplane. Conventional PC I/O is accessible with industry-standard connectors on optional rear I/O modules, as well as SATA, VGA/DVO video, Gigabit Ethernet, and two more USB 2.0 ports. One PMC-X site is provided for additional I/O expansion.

FEATURES:

- Intel® Pentium® M processors supported include 1.0 GHz, 1.4 GHz, or 1.8 GHz
- 2 MB of L2 Advanced Transfer Cache (ATC)
- Low power – less than 20 W maximum power consumption at 1.4 GHz
- Single-slot: VMEbus operation with an onboard CompactFlash disk for bootable mass storage
- 855GME and 6300ESB chipset 400 MTps system bus
- Ultra ATA 100/66/33 IDE protocol
- PCI-X expansion offers 64 bits @ 66 MHz data transfer capability
- Integrated graphics
- DDR-266 support with a memory bandwidth of 2.1 GBps
- Tundra Universe IID PCI-VMEbus interface provides 64-bit VMEbus transfer rates over 30 MBps
- One PMC-X site with 64 bit @ 66 MHz bandwidth is available onboard

For more information, contact: sales@dynatem.com

RSC #87 @www.vmebus-systems.com/catalogrsc

ELTEC Elektronik AG

Galileo-Galilei-Str. 11
Mainz, 55129 DE
Tel: 49-6131-918-0 • Fax: 49-6131-918-195

EUROCOM 148

www.eltec.com

The EUROCOM 148 supports Intel's socket 370 processors such as the Pentium III (or Celeron) with a clock speed of up to 1.266 GHz. The CPU has FPU, MMU, and second level cache. A complete PC kernel, based on the i815 chipset, with integrated graphics is implemented. Onboard memory accommodates up to 512 MB SDRAM. EUROCOM 148 has two 10/100Base-T Ethernet ports, and Gigabit Ethernet is available as an option. It also features two asynchronous serial RS-232 I/O lines, as well as keyboard/mouse connections. Peripheral components can be connected to the onboard PMC slot. The VMEbus interface is implemented in an ASIC containing the PCI-to-VME bridge.

All versions of Windows and Industrial Linux are supported.

FEATURES:

- Intel Pentium III, with i815 chipset, up to 1266 MHz
- Double Eurocard format/single slot; passive cooling (optional)
- 10/100/1000Base-T network interface (1000Base-T)
- Graphics onboard
- Onboard PMC mezzanine board slot

For more information, contact: info@eltec.com

RSC #8801 @www.vmebus-systems.com/catalogrsc

Radstone Embedded Computing

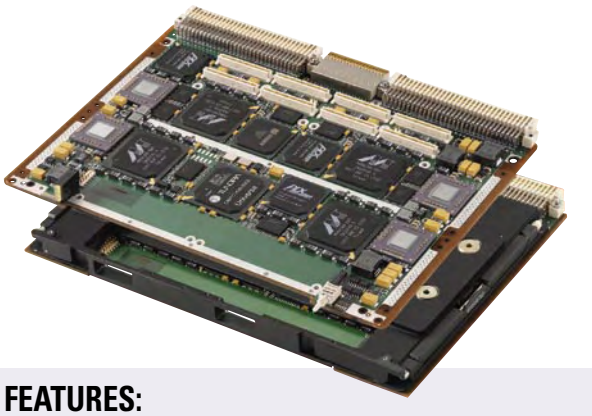
50 Tice Boulevard
Woodcliff Lake, NJ 07677-7645
Tel: 800-368-2738 • Fax: 201-391-2899

G4DSP-XE

www.radstone.com

Radstone's G4DSP-XE incorporates four MPC7447 compute nodes to provide massive signal and data processing performance. At the heart of G4DSP-XE is its AccelerX™ loosely coupled PCI-X architecture enabling ultra fast node-to-node communications.

For fast interprocessor messaging, each compute node provides an interface into a central hardware message passing accelerator. Also provided is a common time base allowing messages and/or data buffers to be time-stamped. Thus, each G4DSP-XE in the system maintains the local time at the same value. Multiboard scalability is greatly enhanced by the use of two StarFabric ports at P0.



FEATURES:

- 4 x MPC7447 @ 1 GHz
- AccelerX™ architecture: 100 MHz loosely coupled PCI-X
- 256 MB DDR SDRAM and 32 MB Flash per node
- 2 x bridged PMC sites
- 2 x StarFabric ports at P0
- 4 x Gigabit Ethernet ports

For more information, contact: sales@radstone.com

RSC #8802 @www.vmebus-systems.com/catalogrsc

SBS Technologies
7401 Snaproll NE
Albuquerque, NM 87109
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VG5 – VME 6U SBC

www.sbs.com

The VG5 is a dual- or single-processor VMEbus computer board designed to meet the needs of high-performance embedded applications. It addresses markets such as aerospace, industrial automation, and any markets where real-time and/or signal processing is needed.

Operating system support includes VxWorks, Linux, and LynxOS.

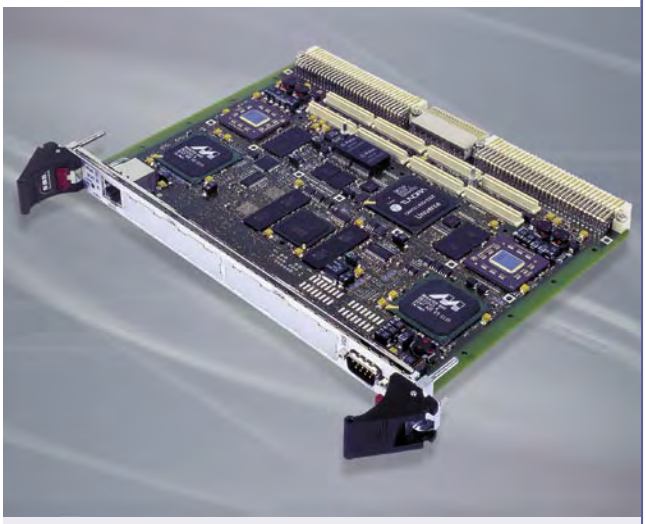
The ultra-compact 6U single slot, all-in-one design includes flexible memory and Flash configurations. Onboard peripherals include up to two GigE (VITA 31.1-compliant) ports, two 10/100Base-T Ethernet ports, up to four high-speed, multi-protocol serial controllers (HDLC, BiSync), one serial-ATA compatible port, two PMC extension slots, and general-purpose I/Os.

Three onboard 64-bit PCI buses are supported in the dual processor version:

- One for 64-bit/100 MHz (PCI-X) connection of the processor nodes
- One exclusively for one 64-bit 33/66 MHz PCI PMC site
- One for onboard VME bridge, SATA, and the second PMC site (PCI-64/33 MHz)

A specific onboard programmable FPGA for peripheral functions or additional I/Os routes signals to the VG5's P2 connector. This enables users to implement proprietary IP or expand the board's I/O connections. This capability allows immediate reaction to functional changes without requiring a board redesign for maximum design flexibility.

The VG5 is available in a rugged configuration that addresses extreme environments with optional conduction cooling for an extended temperature range of -40 °C to +80 °C. The rugged VG5 also provides an enhanced resistance to shock and vibration for use in mobile environments.



FEATURES:

- Dual processor and chipset design for independent processor nodes
- Ruggedized versions with high immunity to shock and vibration, conduction cooling, conformal coating, and a -40 °C to +85 °C temperature range
- A user-programmable FPGA for controlling peripheral functions or additional I/Os; support by available development kit
- Dual PMC sites support flexible mezzanine cards, enabling additional I/O, processing, or other functions
- Custom assembly for specific applications supports optimum price/performance for each application
- Single and dual processor versions available

For more information, contact: info@sbs.com

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Motorola
2900 S. Diablo Way
Tempe, AZ 85282
Tel: 800-759-1107 • Fax: 602-438-3195

MVME3100

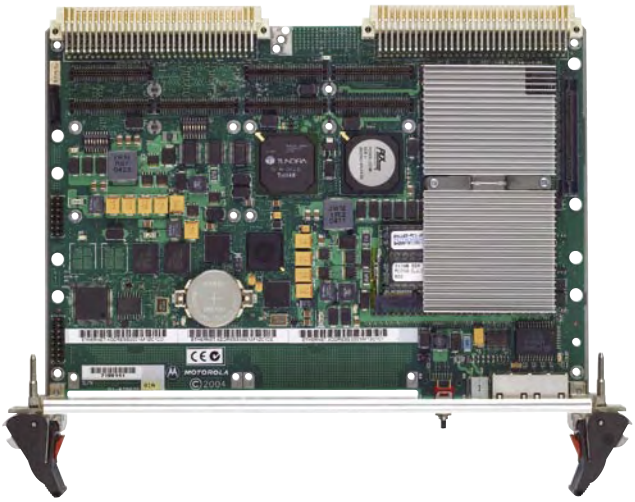
www.motorola.com/computing

The Motorola MVME3100 single-board computer helps OEMs of industrial and defense/aerospace VMEbus platforms add performance and features for competitive advantage while still protecting the fundamental investment in VMEbus and related technologies.

As one of the first VMEbus products with the system-on-chip MPC8540 processor, the MVME3100 offers a growth path for VMEbus customers with applications on the previous generation of MPC8245 and similar processors. The system-on-chip implementation offers power/thermal reliability and life-cycle advantages not typically found in alternative architectures. The faster processor and 2eSST VMEbus interface (the same as on Motorola's MVME6100) combine to offer significant performance improvement.

New cost-effective peripherals can now be integrated easily using USB and SATA interfaces. SATA represents a significant cost reduction opportunity from older SCSI technology, with generally lower drive pricing for equivalent capacity.

Customers can also keep their VMEbus infrastructure (chassis, backplanes, and other VMEbus and PMC boards) while improving performance and extending the life cycle. Also, the extended life cycle of Motorola computing products helps reduce churns in development and support efforts resulting from frequent product changes.



FEATURES:

- System-on-chip MPC8540 with PowerPC® processor core, integrated memory controller, PCI-X interface, and I/O
- Gigabit Ethernet ports for connection to enterprise and real-time networks
- USB 2.0 and SATA controllers for integrating cost-effective peripherals
- 2eSST VMEbus protocol offering interoperability with products such as the MVME6100 at higher bandwidths
- Board support packages for VxWorks and Linux
- Expansion capability – dual PMC-X sites for expansion via industry standard modules; support for PMCspan
- MVME721 Rear Transition Module (RTM) enables I/O routing through back of VMEbus chassis
- Planned for Restriction of Hazardous Substances (RoHS) compliance

For more information, contact: inquiry@mcg.mot.com

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RIO4 8070/RIO4 8076

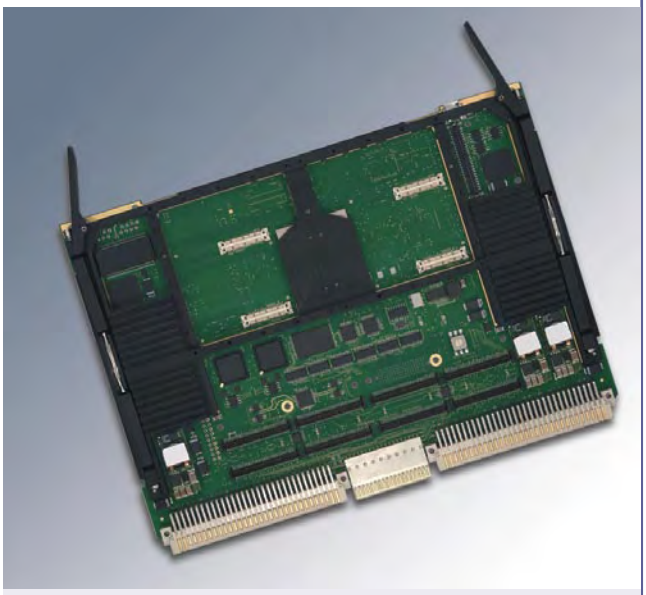
www.ces.ch

The RIO4 8070 and the RIO4 8076 are designed for the most demanding applications, which combine very high processing power along with harsh environment conditions. Typical targets include UAVs, radars, and military aircraft. The RIO4 8070 shares the same PCB as the RIO4 8076, although the RIO4 8076 is the full conduction-cooled specification model.

The RIO4 8070 and the RIO4 8076 are designed for ultimate high-throughput acquisition combined with real time data processing. Their computing elements use the latest PowerPC G4 processor, an FPGA, and a set of high-speed serial links handled by a unique CES multiport control logic incorporating user-controlled bandwidth. Each board hosts two PMC sites, which can be powered ON/OFF independently. Each board also hosts a user-dedicated Virtex-II Pro FPGA to handle user-specific applications. The boards are equipped with a full Secure Cells package for monitoring current, voltage, temperature, bus bandwidth, etc., and enabling reload, reconfiguration, and bypass decisions in real time.

CES, as a system company, designs in-house, both hardware and software elements comprising a Board Support Package (BSP) and offers the package as a bundle, where all of the available hardware functions are supported by software. The RIO4 8070 and the RIO4 8076 are available with the general-purpose Linux® toolkit, as well as with CES extended BSPs for VxWorks® and Integrity®. CES AE 653 BSPs are also available. When equipped with two CPUs, the board can run two different operating systems (Linux® on one CPU, and VxWorks® on the other).

Related CES conduction-cooled models include:
- PEB 6426 – PMC extension board
- MFCC 8446 – Multifunction computing core PPMC
- GPIO 8406 – User-programmable I/O PMC
- MIL-5364 – MFCC-based MIL-STD-1553B PMC
- ARINC 8429 – ARINC 429 PMC
- CAN 8428 – CANbus PMC
- ACS 6060 – ARINC 600 Chassis



FEATURES:

- Single or dual computing node
- Each node equipped with a PowerPC G4 at maximum available frequency, and a Virtex-II Pro FPGA with private ultra-high-speed SSRAM
- Two Gigabit Ethernet interfaces
- Two PMC sites with RocketIO interface
- VME 64x 2eSST AND two separate PCI buses
- VXS or PCI interface on P0
- Onboard Virtex-II Pro FPGA for user-defined applications
- Onboard NAND Flash memory with Fast File System
- Backplane real-time distribution logic
- Full secure cells real-time reconfiguration logic

For more information, contact: ces@ces.ch

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SBS Technologies
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Albuquerque, NM 87109
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VXS1 PowerPC SBC

www.sbs.com

The VXS1 is a rugged, 6U VME PowerPC single board computer that works with other SBS products to bring 10 GBps InfiniBand switched fabric technology to VME systems, utilizing the VITA 41 specification.

The VXS1 features a G4 PowerPC processor with core processing speeds from 500 MHz to 1 GHz and a 167 MHz system bus. It includes two independent InfiniBand 4x links through VME_P0 and provides InfiniBand and system control traffic termination.

The VXS1 also provides I/O connectivity through two GigE ports to the backplane, one 64-bit 66 MHz PCI bus interface, and one 64-bit 66/133 MHz PCI-X interface, as well as two MPSC ports that provide RS-232 (COM1) and RS-422 (COM2) rear I/O ports.

The VXS1 also hosts a single-wide PMC site that supports a standard IEEE1386.1-2001 PMC module for expanding I/O capability. The PMC site is attached to the 64-bit 66 MHz PCI Bus 1, which it shares with the VME bus bridge. This PMC site also includes a 64-bit I/O bus that connects PMC_J14 to VME_P2, per VITA 35.

Leveraging the VITA 41 specification, which enables switched serial fabrics on VME systems, the VXS1 is designed to provide directly-connected, VME-based processing power for InfiniBand-based systems. The VXS1 connects directly to other InfiniBand infrastructure including host channel adapters and switches in various form factors from SBS and other vendors.

The VXS1 is offered as a ruggedized conduction-cooled processor card and is also available in convection-cooled configurations. It is compatible with VITA 1.7 systems.

FEATURES:

- MPC7447A G4 host PowerPC 1 GHz processor with 512 KB on-chip L2 cache
- MV64460 PowerPC System Controller (Discovery III) bridge chip
- MT23108 InfiniBand Host Channel Adapter with 128 MB of control memory
- 2eSST VMEbus: Tsi148 VMEbus bridge
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- Adheres to VITA 41 specification for switched fabric connections on VME
- DDR SDRAM: 512 MB, or 1 GB with ECC
- Soldered boot Flash 256 MB with write-protection
- Available now

For more information, contact: info@sbs.com

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MEN Micro, Inc.
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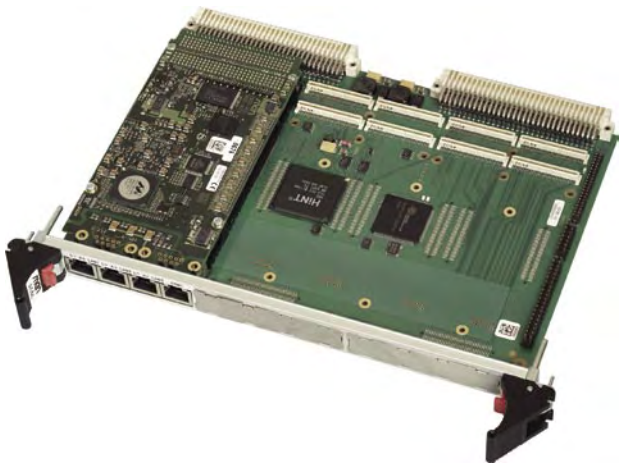
VME64 PowerPC SBC

www.menmicro.com

The A14 is an advanced, PowerPC-based, VMEbus SBC for embedded applications. With full VME64 support it can be used as a master or as a slave. The A14 has a proprietary high-speed VMEbus interface with 1 MB SRAM for VMEbus slave access and communication between the onboard processor and another VMEbus master. The A14 features a 1 GHz MPC8540 PowerPC processor, which is available for the industrial temperature range (-40 °C to +85 °C). The A14 is equipped with socketed, fast DDRAM with ECC for data storage, NAND Flash for program storage, and non-volatile FRAM. The A14 has two Gigabit Ethernet ports, one fast Ethernet and one COM interface, all with front panel access via four RJ-45 connectors. Additional interfaces available on the MPC8540 are routed to the rear I/O connector. And, as an option, four UARTs are accessible via MEN's SA-Adapters for front or rear connection.

Additional functionality, including graphics, touch screen, CAN, binary I/O, and others, can be configured in the A14's FPGA. Physical interfaces for the FPGA are available via SA-Adapters on the front panel or on a transition module in the rear. The FPGA behaves like a standard PCI component. VHDL functional code for the FPGA is available from MEN. Internally, the FPGA is connected via the standard Wishbone bus. The FPGA functions are loaded in less than 200 ms when the system is powered up and FPGA functionality can be updated dynamically during operation.

In addition, the A14 can support two 64-bit/66 MHz PMC mezzanine cards with front and/or rear I/O (PIM). The A14 is supplied with MEN Monitor (MENMON), a type of BIOS from MEN for bootstrapping operating systems (from disk, Flash, or a network), for hardware testing, and for debugging applications when not running a full operating system.



FEATURES:

- Single board computer with 800 MHz to 1 GHz MPC8540 PowerPC
- e500 PowerPC core with integrated Floating Point Unit (FPU) and Memory Management Unit (MMU)
- Single slot 64-bit VMEbus master or slave
- Up to 2 GB of DDRAM with ECC
- NAND Flash and FRAM
- Graphics supported via an onboard FPGA or PMC card
- Two GB Ethernet ports and one Fast Ethernet port
- As many as six serial communications lines
- Parallel ATA for onboard hard disk
- Configurable FPGA for additional application-specific I/O
- Two PMC slots onboard
- MEN Micro's MENMON BIOS for PowerPC SBCs

For more information, contact: egodsey@menmicro.com

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SBS Technologies

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IB4X-V41

www.sbs.com

IB4X-V41 is a high-performance, 24-port 4x InfiniBand switch in a VITA 41 form factor. This switch overlays high-speed switched serial interconnects on the standard VME backplane.

Delivering greater than a magnitude of bandwidth increase to the VME backplane, this switch is ideal for embedded systems in military, COTS, medical imaging, and telecommunications markets. The IB4X-V41 has 18 payload connections, 4 inter-switch connections, and 2 front-panel copper connectors that can be converted to fiber through an SBS IB4X-OMC media converter. The IB4X is designed to withstand temperatures from –40 °C to +85 °C.

FEATURES:

- Complete, 24-port, 4x InfiniBand switch in VITA 41 form factor for use in VME systems
- Massive increase in aggregate switch bandwidth on VME – 480 Gbps
- Fully non-blocking internal switch architecture and support for cut-through and store and forward algorithms
- 18 payload ports and four inter-switch links
- InfiniBand v1.1 and VITA 41, 41.1, and 41.10 compliant
- Conduction-cooled and air-cooled versions available

For more information, contact: info@sbs.com

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FEATURES:

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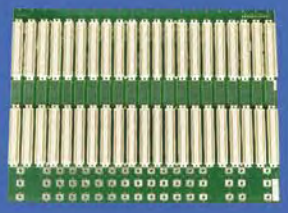

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33	Motorola – Processor Boards	97	VMETRO Transtech – MDR Data Recorders
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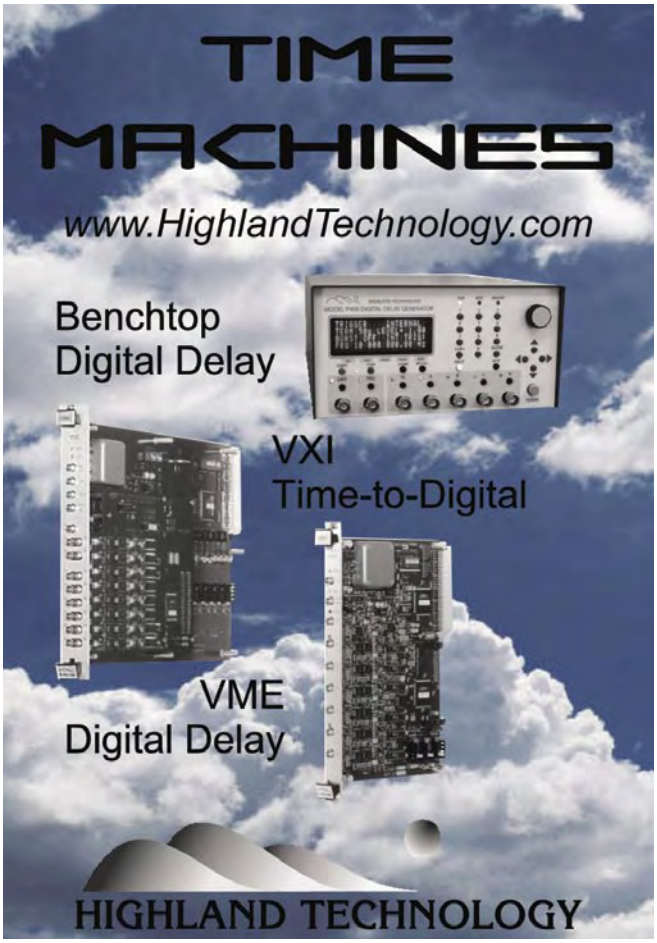

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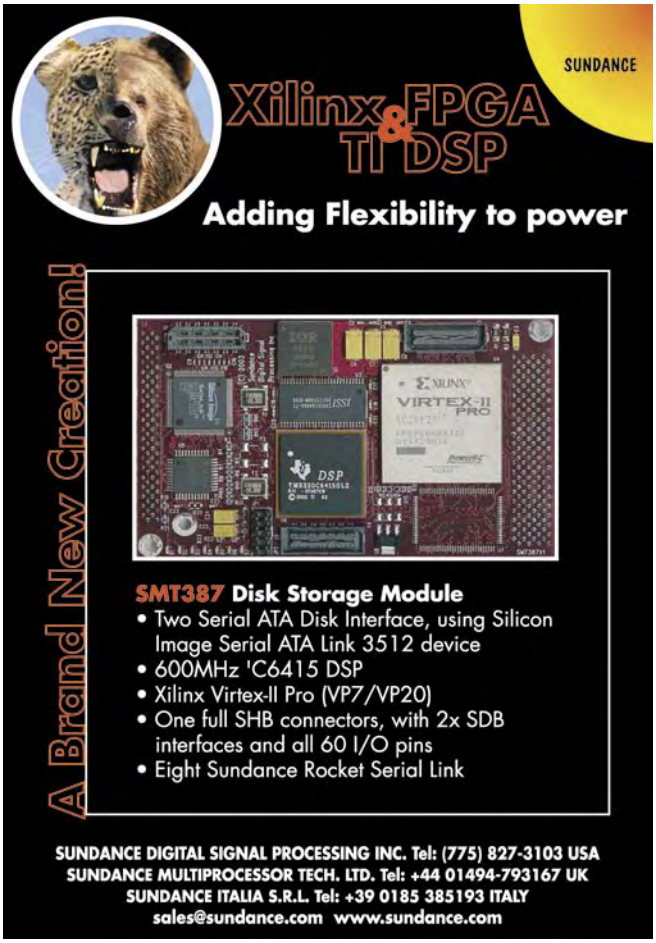
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